

MACHINERY

PUBLICATION OFFICES 140-148 LAFAYETTE STREET, CORNER HOWARD, NEW YORK



COMPLETED

Our New Catalog of Detroit Twist Drills.

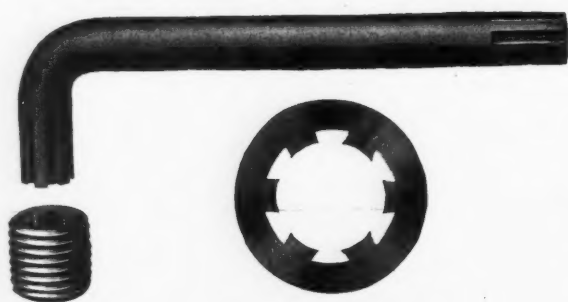
Within its two hundred and fifty some odd pages you will find complete up-to-the-minute data and information covering sizes, lists, usages, etc., on twist drills, reamers, cutters and other small tools—representative of the best modern practice.

Helpful information in the form of rules and tables has been incorporated with a view to making this catalog one of the most complete and practical reference books of its kind ever issued.

Your copy will be mailed immediately upon request.

Detroit Twist Drill Company
Detroit, U. S. A.

HOLDS LIKE A VISE



TRADE MARK
BRISTO
REG. U. S. PAT. OFFICE



TRADE MARK
BRISTO Safety Set Screws are simple in design, yet designed in a manner which assures the best results in service.

Extreme pressure applied to Bristo Set Screws will not expand or split them; the dove-tail design tends to *contract the metal*. Wrench and screw cling together.

Adjustment of Bristo Safety Set Screws is quick and easy; the wrench will not slip out of the screw and you never have to ease the pressure for fear of spreading the hole round.

Samples, placed in your hands, will show you the advantages of the design and will open your eyes to a better set screw than you have ever used.

Write for samples and Bulletin 809-E.

THE BRISTOL COMPANY, Waterbury, Conn.

Branch Offices: Boston New York Pittsburgh Chicago San Francisco

LINDE OXYGEN

SERVICE — EFFICIENCY — CONVENIENCE — ECONOMY

From Coast to Coast 53 Plants and Warehouses provide an unlimited supply of LINDE OXYGEN for thousands of users everywhere

Linde Oxygen may be obtained direct from any of our plants or warehouses. Mail or 'phone your order to THE LINDE AIR PRODUCTS CO., at any of the following points.

DISTRIBUTING STATIONS

ALABAMA Birmingham (Plant) 10th Ave. and 28th St.	LOUISIANA New Orleans 861 Fulton St.	NEW YORK Newark 354 Plane St.	Pittsburgh 16th and Pike Sts. Trafford
COLORADO Denver 1550 Glenarm St.	MARYLAND Baltimore (Plant) 25th and Montebello Ave.	Albany Montgomery and Colonie Sts.	TENNESSEE Chattanooga 212 to 238 King St.
DISTRICT OF COLUMBIA Washington 9th and Maryland Ave., S.W.	MASSACHUSETTS Cambridge 25 Waverly St.	Brooklyn 475 Driggs Ave.	Memphis 203 Washington St.
GEORGIA Atlanta (Plant) Plyant St. and Southern R.R.	Springfield Napier St.	Buffalo 155 to 183 Chandler St.	WISCONSIN Milwaukee (Plant) 36th St. and National Ave.
Savannah Ogeechee Canal, S. of Bay St.	Worcester 961 Southbridge St.	New York City 217 W. 29th St.	PACIFIC COAST
ILLINOIS Chicago (North Side) 113 Austin Ave.	MICHIGAN Detroit (Plant) St. Aubin Ave. and Newton St.	Utica Walnut and Schuyler Sts.	CALIFORNIA Emeryville, Oakland (Plant) Los Angeles (Plant) 1405 Mission Road
Chicago (West Side) 1501 S. Peoria St.	Grand Rapids Pearl St. by the Bridge	OHIO Cleveland (Plant) E. 73d and Bitten Ave.	OREGON Portland 15th and Hoyt Sts.
East St. Louis 6th and Walnut Ave.	MINNESOTA Duluth Seventh Ave., West	Cincinnati 63 Plum St.	UTAH Salt Lake City 112 West Second St., South
INDIANA East Chicago (Plant) Fort Wayne 414 E. Columbia St.	MISSOURI North Kansas City (Plant) 14th and Charlotte St.	Columbus 310 Dublin Ave.	WASHINGTON Seattle 530 First Ave., South
Indianapolis 2819 Roosevelt Ave.	St. Louis 4218 Forest Park Blvd.	Dayton 521 E. First St.	TEXAS Dallas (Plant) Harwood and Coombs St.
IOWA Davenport 118 Harrison St.	NEBRASKA Omaha 1007 Jones St.	Toledo 414 S. Erie St.	Houston Cedar and Baker Sts.
Des Moines 117 W. 5th St.	NEW JERSEY Elizabeth (Plant) Linden Ave.	OKLAHOMA Oklahoma City 27 E. Grand Ave.	San Antonio 512 Dolorosa St.
KENTUCKY Louisville 126 E. Main St.		Pennsylvania Norristown (Plant) No. Philadelphia (Plant) 18th and Cambria Sts.	

THE LINDE AIR PRODUCTS COMPANY, FORTY-SECOND STREET BLDG. NEW YORK, N. Y.

LARGEST PRODUCERS OF OXYGEN IN THE WORLD

Other Plants are planned for other industrial centers throughout the country and will be established as fast as and wherever the local demand for oxygen warrants.



Copyrighted by Underwood & Underwood.



WAR stimulates the invention of destructive devices and promotes the adaptation of machines to offensive purposes for which they were not originally

planned. One of the strange developments of the European struggle is the so-called "tanks," those lumbering land battle-ships, invulnerable to machine-gun fire, that travel over ground plowed by shells, and cross ditches, crawl up precipitous banks, push down walls, and accomplish that which would be impossible for any of the four-wheel type motor trucks. The tanks are adaptations of an American invention, being reconstructed caterpillar¹ tractors built in the United States and invented by Benjamin Holt, president of the Holt Mfg. Co., of Stockton, Cal., and Peoria, Ill.

Benjamin Holt was born in New Hampshire and had New England thrift and native Yankee inventive ability. He went to California in the early eighties, and with his brothers established a factory at Stockton for building wagons and farm implements. The vast agricultural areas, the forests and the great mines of the Pacific coast all demanded new methods of farming, lumbering and mining. Twenty-five years ago Mr.

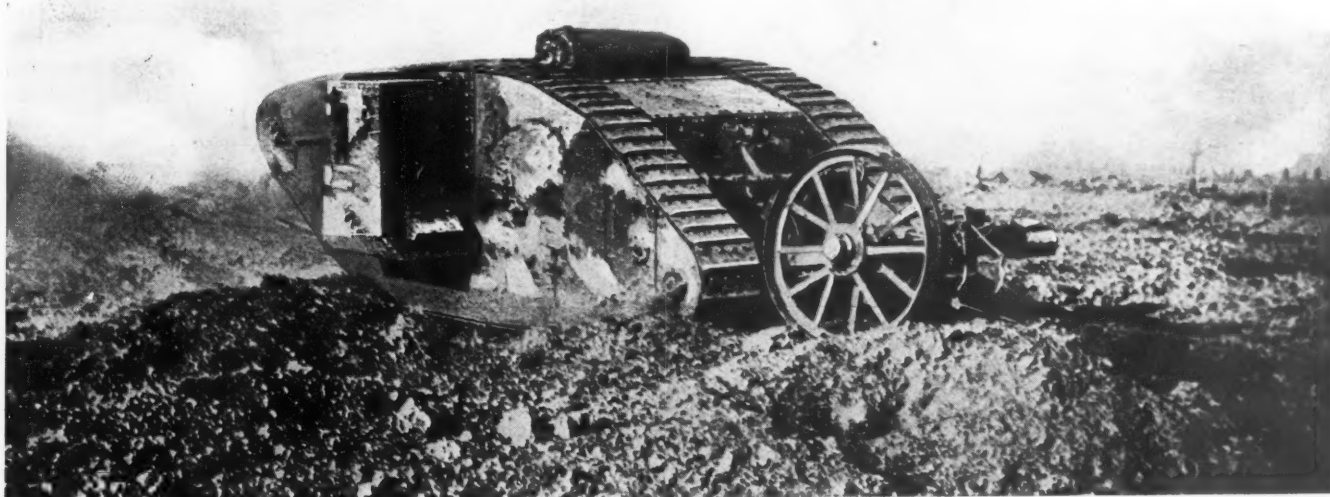
The importance of road transportation in times of war and peace warrants the presentation of this article on the design and construction of the Holt Mfg. Co.'s caterpillar tractor, which is the foundation of the British and French "tanks," and in many respects the most remarkable machine ever developed for any purpose.

Holt invented the Holt combined harvester and thresher, which cuts and threshes the grain at one operation. This machine quickly came into extensive use in the Pacific coast states.

Mr. Holt then began the manufacture

of steam traction engines for pulling gangs of plows and other tillage implements, but these engines were only partially successful, as the soft lands of the San Joaquin valley could not support the weight, although driving wheels were built as large as eight feet wide and twelve feet diameter. These were too heavy and cumbersome and did much damage to the surface traversed. Then realizing that the reason for using such enormous driving wheels was simply to obtain the projected area on the ground required to support the weight, Mr. Holt, in 1904, discarded the large-diameter, wide-tire wheels and designed a virtually flat wheel in the form of an endless sectional track which the tractor first lays down, rolls over and then finally picks up one section at a time, thus giving a solid steel road-bed to travel on. The belts were provided with guide wheels similar to an animal tread power, and, in fact, the driving elements or track assemblies are identical in principle with tread powers; they are laid on the ground

¹The term "Caterpillar" used throughout this article is copyrighted, and has reference only to the tractor made by the Holt Mfg. Co.



Copyrighted by Underwood & Underwood.

and pushed by engine power instead of being pushed by animal power. The engine drives through sprocket wheels, which engage the links of the belt or chain. This form of driving element can be proportioned to give almost any required area to support the load, and it was found to have certain other valuable characteristics not possessed by the traction engine. It not only had great tractive power, but could be maneuvered much more easily. It is possible to turn a caterpillar

within its own length and to traverse broken ground that would stop any wheel vehicle. The reason for the latter is that the belts bridge narrow ditches and support the engine without dropping in and having to climb out. If the ditch is broad, the great tractive power enables the machine to cross even if the sides are inclined at as steep an angle as 45 degrees.

The Holt Mfg. Co.'s caterpillar tractors are built in four sizes, viz., 18, 45, 75 and 120 horsepower. The 18- and 45-horsepower sizes have no pilot or leading wheel. The larger sizes with greater power and a longer wheel-base are employed for heavy hauling, as well as for agricultural work, having power sufficient for pulling large gangs of plows or several loaded trailers, doing construction work and other labor requiring great tractive power. The 75-horsepower tractor weighs 24,000 pounds and develops a draw-bar pull of 9000 pounds; the 125-horsepower tractor develops 12,000 pounds draw-bar pull.

The tractors are equipped with internal combustion four-stroke cycle engines with four and six cylinders. The six-cylinder engines are used on the 75- and 120-horsepower tractors, while the 18- and 45-horsepower sizes have four-cylinder engines. The 45- and 75-horsepower motors are built in the Stockton plant, and the Peoria plant is devoted principally to the construction of the frames, track assemblies, clutches, transmission gears, and all the other principal parts. A few six-cylinder engines with certain special features for military tractors are built in the Peoria plant. The general design of the engine does not differ radically, however, from that of the engines for motor trucks except in general ruggedness and strength, being comparatively slow speed and heavy

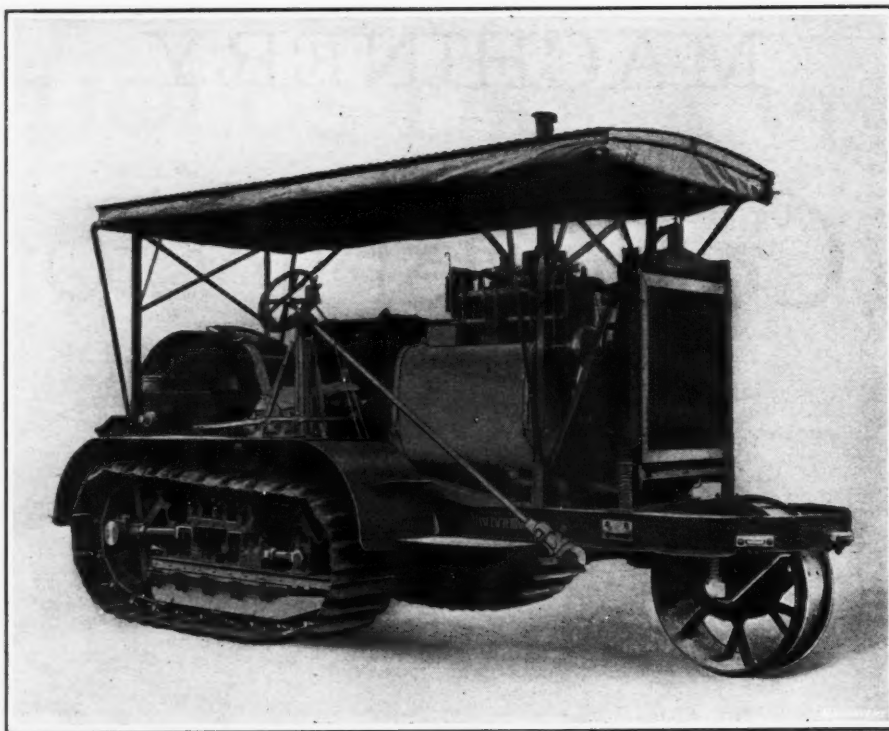


Fig. 1. Seventy-five-horsepower Internal-combustion Motor Caterpillar Tractor

ly increased tractive power momentarily. It is because of the peculiar features of the driving gear and the low unit pressure of the tractor on the earth that the Holt caterpillar can cross gullies, plow through mud, and pull a load where other tractors would be practically helpless.

The control of the Holt tractor is different from that of the ordinary motor truck. On the 45-horsepower tractor the operator's seat is at the rear, where he has at his hand and feet three clutches to operate, two for steering and one—the master clutch—for controlling the transmission of power from the engine to the driving gear. The master clutch must be pressed into engagement by the operator when he wishes to drive, instead of employing the pressure of a coiled spring, as in the transmission of the ordinary motor car. The two steering cone clutches are located in the jack-shaft. To turn the tractor to the right, the operator releases the right-hand clutch partially or entirely, depending on the shortness of the turn required, and drives with the left-hand clutch, causing the machine to curve to the right. If a very short turn is to be made, the right-hand clutch is fully disengaged and the brake applied to the clutch drum, thereby locking the driving gear on the right-hand side and causing the machine to pivot on the

center of the right-hand track assembly. Thus it is possible to turn the tractor easily within its own length.

Caterpillar tractors are manufactured, but all the parts are not made strictly interchangeable, although they are practically so. For instance, the bearings for the transmission shafts are babbitted with babbitting jigs and are afterward reamed, scraped and fitted to their respective shafts, thus securing close fits,

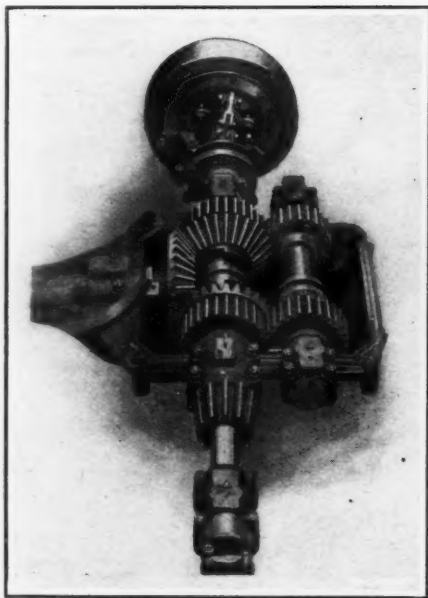


Fig. 2. Master Clutch and Transmission Assembly of 75-horsepower Tractor

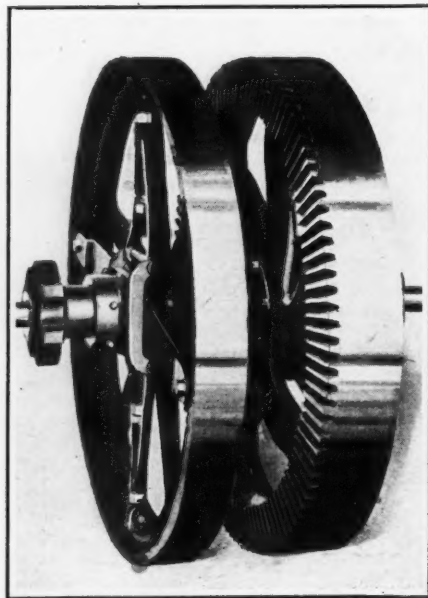


Fig. 3. Main Drive Gear and Friction Wheel of 75-horsepower Tractor

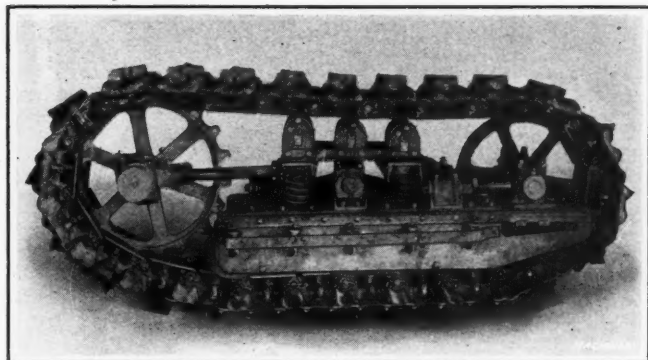


Fig. 4. Track Assembly of 75-horsepower Holt Caterpillar Tractor

smooth action and durability. When replacements are necessary, some refitting may have to be done. The frame is bent to shape over forms and the bearing castings are set, the holes are drilled and then reamed in position. The general practice is the same as that followed by locomotive builders. The effort is to secure a strong, well-knit construction that will withstand indefinitely the shock and wear of use.

Cut gears are used throughout the transmission. The bevel gears are planed on Gleason bevel gear templet planers. Great

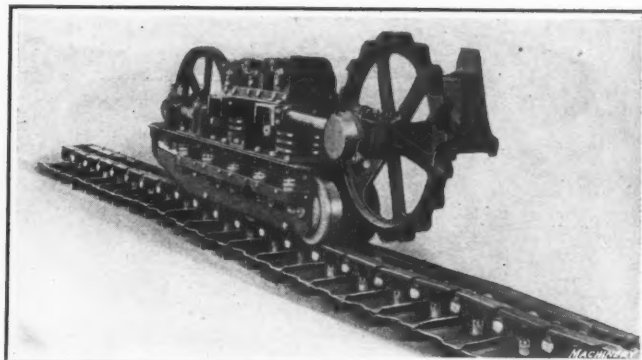


Fig. 5. Track Assembly with Track opened out, 75-horsepower Tractor

eral thousand pounds and that propels the machine under the most severe deteriorating influences is an accomplishment worthy of the highest commendation. The structure is made to exclude dirt to a considerable extent, but it works without trouble or rapid wear when submerged in mud or sand.

The steel track of the caterpillar is composed of links, connected by casehardened pins and bushings, and plow steel plates pressed into shape while hot. Each link is a double rail over which the track rollers revolve. A plow steel plate

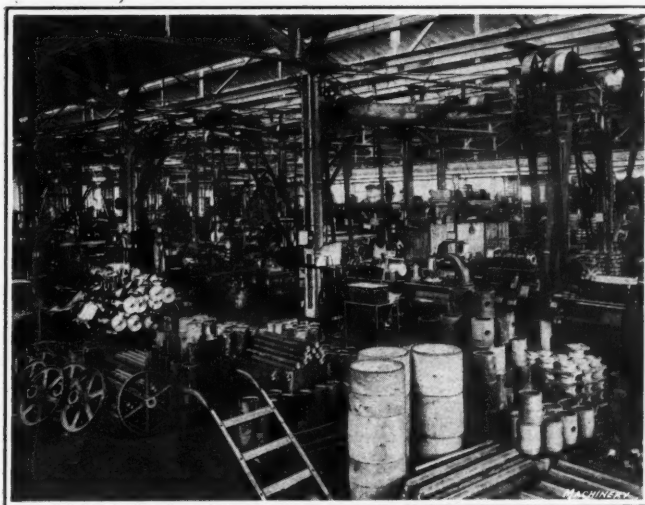


Fig. 6. Machine Shop of Holt Mfg. Co., Peoria, Ill.

care is exercised to obtain perfect alignment of engine crankshaft bearings, the boring being done on Lucas horizontal machines.

The working parts of the caterpillar that excite the liveliest interest in the mechanic are the track assemblies. In these we have a mechanism exposed to dust, sand, mud and water, while working under heavy stress. To have designed and constructed a flexible steel track that sustains a load of sev-

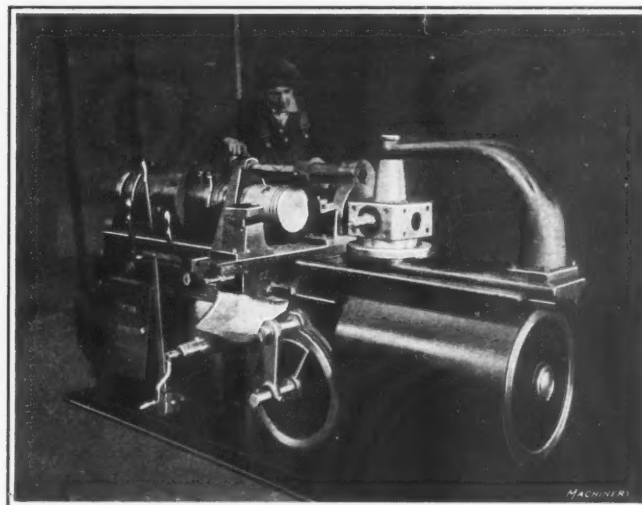


Fig. 7. Potter & Johnston Automatic Lathe turning Pistons

of high tensile strength is attached to each link. The plates have curved ends and overlap, so there is no opening between them in any position. They are made sufficiently heavy to withstand severe use and, owing to the design and materials used in construction, are extremely durable. There is little or no friction between the plates and the ground, the track being merely laid down and picked up again, one section at a time.

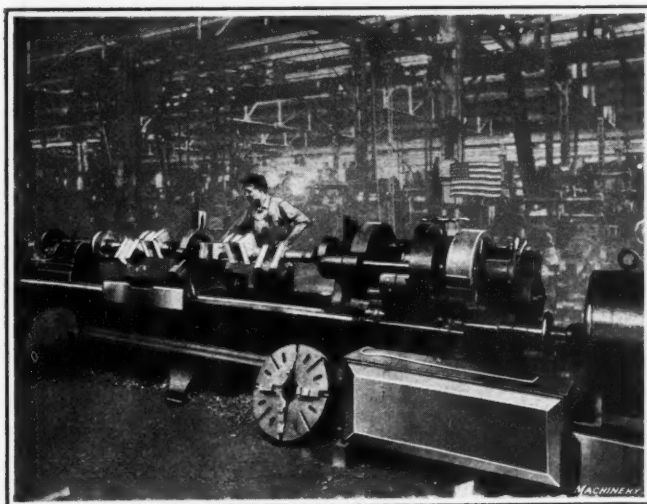


Fig. 8. Turning Six-throw Crankshafts for 120-horsepower Engine

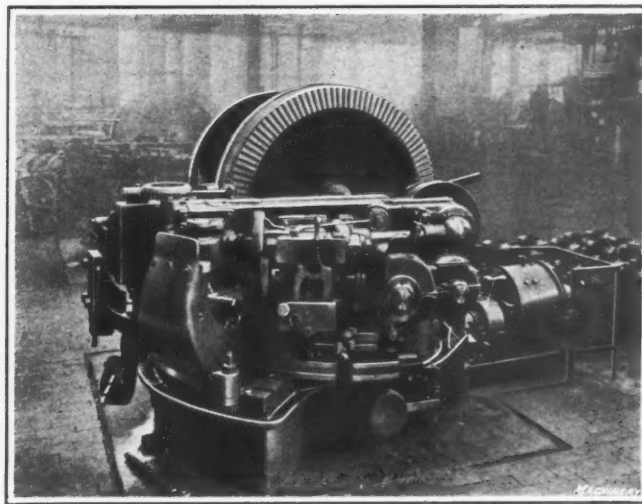


Fig. 9. Gleason Templet Gear Planer planing Bevel Main Drive Gears

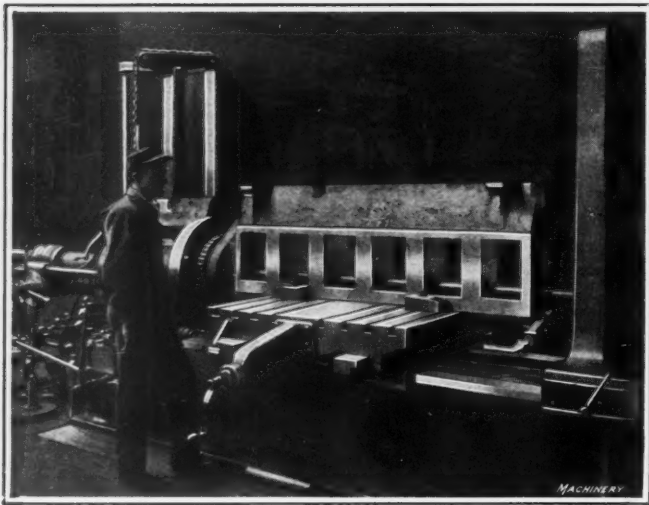


Fig. 10. Lucas Horizontal Milling and Boring Machine boring Bearing for Six-cylinder, 120-horsepower Crank-cases

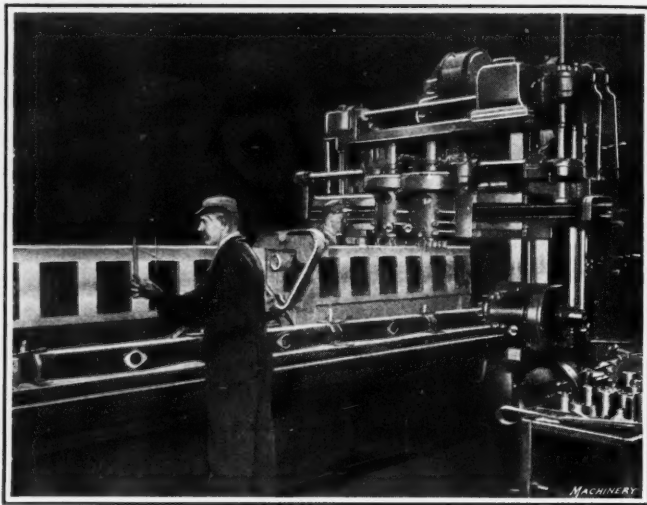


Fig. 11. Ingersoll Milling Machine working on Crank-case of Six-cylinder, 120-horsepower Engine and Radiator Headers simultaneously

The extraordinary capacity of the caterpillar to travel over soft ground is due in large part to the low unit pressure imposed on the supporting track. There are usually eight track links or shoes on each track of a 45-horsepower tractor in contact with the ground, so that with the standard 13-inch width tracks the total bearing surface is 2080 square inches and the ground pressure is only $6\frac{1}{4}$ pounds per square inch. For very soft ground, special 30-inch width tracks are provided, giving a total bearing surface of 4800 square inches and reducing the ground pressure to 3 pounds per square inch, or 432 pounds per square foot. This pressure is much less than the foot pressure of either man or horse; hence it is obvious that

the heavy tractor can work over soft soils, and will pack the ground less than horses.

The load is transferred on each side of the 45-horsepower caterpillar to five truck wheels or rollers, spring-supported beneath the main frame. The driving sprocket is at the rear and small rollers are provided at the top for supporting the chain as it travels to the blank sprocket or idler at the forward end. The truck rollers have chilled faces and revolve on heat-treated shafts fitted with long phosphor-bronze bearings provided with grease cups. The hubs are counterbored to receive washers that are ground to size. The washers act as a thrust bearing and exclude dust, sand and dirt.



Fig. 12. Main Erecting Shop of the Holt Mfg. Co., Peoria, Ill.

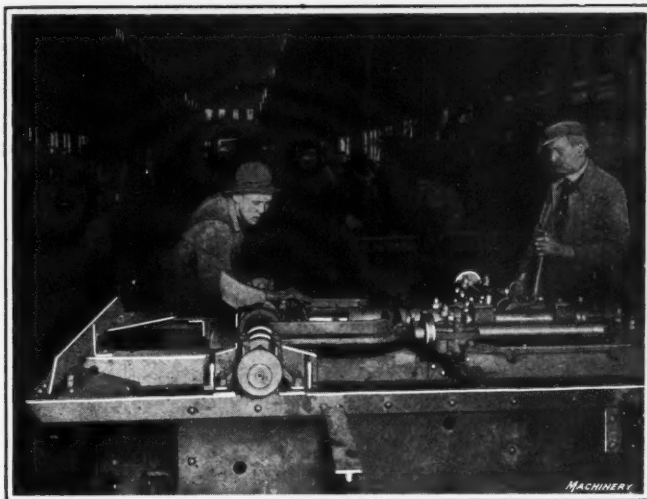


Fig. 13. Babbitting Jig used for Bearings of 75-horsepower Tractors

The gasoline tanks are made of galvanized sheet steel, rolled and spot-welded closely at the seams. The heads are formed with shallow flanges and set in place with the flanges outward in the spot-welded shell. The heads are closely spot-welded to the shell and then all seams are soldered. The spot-welding process of uniting the seams is rapid and effective; the spot-

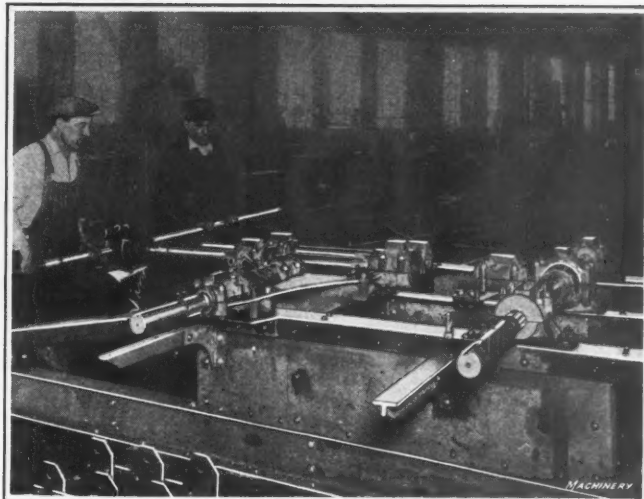


Fig. 14. Power Reamer for reaming Bearings on 75-horsepower Tractor

Motor trucks and tractors are being widely used in the European war for hauling in place of horses. The movement of great guns and supply trains with the speed and rapidity accomplished would have been out of the question if the armies had to depend on horses. The extent to which mechanical traction is used is indicated in a manner by the fact that the

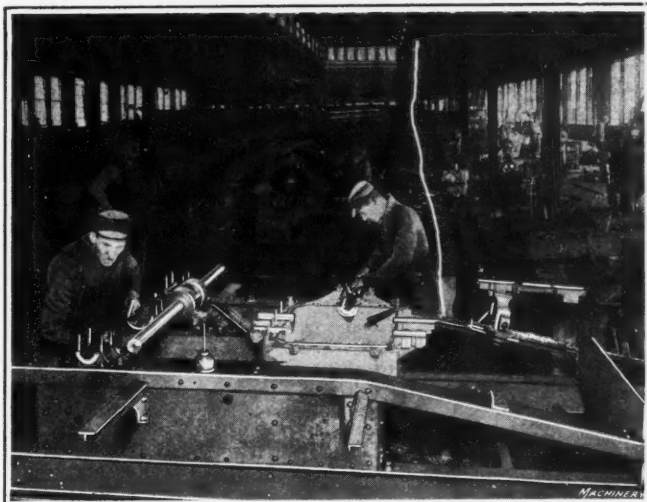


Fig. 15. Scraping Bearings for 75- and 120-horsepower Tractors

welds give the seam the necessary strength to hold and the solder seals the joints.

All tractors are subjected to a shop test of several hours' duration, running under brake load, to tune them up and get the bearings broken in. After the brake test, each tractor is taken out and driven about under heavy load until the operator is satisfied that it is fit for average road conditions.

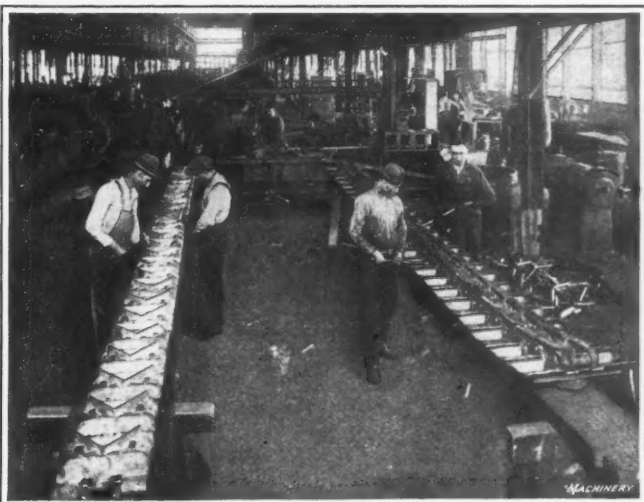


Fig. 16. Assembling Tracks for 75-horsepower Tractors

Holt Mfg. Co. has sold over three thousand caterpillar tractors to the European countries, chiefly Great Britain and France. The advantages of motor-driven tractors are greater concentrated power than is possible with horses, freedom from disease, smaller number of men required to drive and care for them, capacity to travel continuously over rough roads, and possibility of being restored to use when damaged by shells.

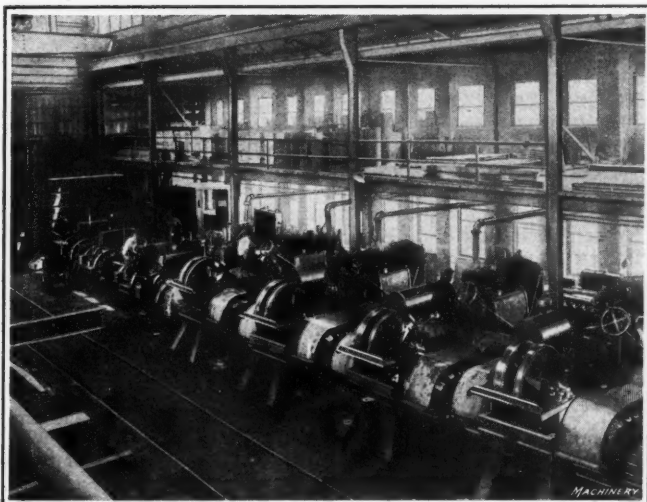


Fig. 17. Holt Caterpillar Tractors undergoing Shop Test on Blocks



Fig. 18. Seventy-five-horsepower Tractor, hauling Supply Train in Texas



Fig. 19. Seventy-five-horsepower Tractor crossing Deep Gully on Expedition



Fig. 20. Tractor at Bottom of Gully Ready to ascend Opposite Bank



Fig. 21. Holt Caterpillar having crossed Gully and ascended Opposite Bank

In view of the advantages of mechanical traction, particularly as shown in the European war, the United States Army has made an exhaustive study of the general problem of haulage and military supply trains. These tests began in 1915 and have steadily continued; they have included all the various field operations of the Quartermaster Corps, Engineers' Corps, light and heavy Field Artillery, Signal Corps, etc. Caterpillar tractors were found indispensable in building and maintaining roads for the motor truck trains during the expedition into Mexico in 1916; they are being used for hauling supply trains through the Big Bend District, Texas, where the troops guarding the Rio Grande boundary are from sixty to one hundred miles from the base of supply at Marfa. The Big Bend District consists principally of steep, rough mountain grades and desert roads. For the first time in the history of the United States Army, tractors were used in March, 1917, for hauling supplies in connection with marching troops. The initial trip was made from Fort Sam Houston to Laredo, a distance of 170 miles, where caterpillar 75-horsepower tractors accompanied the 37th Infantry, and after reaching Laredo, made the return to Fort Sam Houston with the 9th Infantry. It was necessary for the tractors at all times to maintain the speed of the marching regiment, so as to make camp each day on time with the regimental supplies. Although many severe road conditions were encountered, the tractors successfully met all requirements without mishap or breakage. Fig. 18 shows the supply train accompanying the 37th Infantry, consisting of fifteen Troy trailers, fourteen of which were of 1½ ton capacity and one of 3 tons capacity. The total weight of the trailers is 15 tons and of the cargo 30 tons, making a net hauling weight of 45 tons. One of the regular army escort wagons was later added, making the total hauling weight 53 tons. It would have required thirty army escort wagons with four mules each to handle this same tonnage.

Tractors are formidable in war, but they will achieve greater victories in times of peace. There is no doubt that agricultural work on large farms of the West and on many of the smaller farms of the East will eventually be done almost exclusively by means of tractors, and this, of course, applies also to agricultural work in all the countries of the world. The machine that has great pulling power, which can be used on soft soils and turn within its own length is at an advantage as compared with those requiring a large turning radius and firm soils to work efficiently for purely agricultural purposes. For long overland hauling, especially where bad roads exist, the caterpillar tractor has proved capable of hauling at a lower cost per ton mile than by other methods. For road hauling where greater speed is required and comparatively small tractive power is needed by reason of uniformly good roads, the four-wheel motor truck has some advantage, but no wheel vehicle can follow the caterpillar type tractor through muddy, sandy and rough roads or over steep grades or where no roads of any kind exist.

F. E. R.

The by-products of the 48,000 sawmills in the United States, in the form of sawdust, shavings, slabs, etc., is estimated at 36,000,000 cords a year. About one-half of this is used as fuel, but the remaining 18,000,000 cords is a source of danger to the mill and requires the expenditure of time and money for its disposal. As the production of this waste is unavoidable, the forest service is seeking some way of turning it to account.

INDUSTRIAL EXPOSITION AND EXPORT CONFERENCE

The first annual Industrial Exposition and Export Conference of the allied industries of the United States was held at the Eastern States Exposition Grounds, Springfield, Mass., June 23 to 30. The purpose of this exposition and conference is to develop export opportunities for American manufacturers and to discuss problems incident to the supplying of foreign markets with American goods.

Thursday, June 28, was "Metals Day," and at the morning session, presided over by Charles E. Hildreth, general manager of the National Machine Tool Builders' Association, the following papers were presented:

"After the War—What of Machinery Export?" by C. O. Smith, Export Manager, Norton Grinding Co., Worcester, Mass.
"American Tools in Foreign Markets," by Oren O. Gallup, New York City Export Manager, Simonds Mfg. Co., Fitchburg, Mass.

"Metal Fittings in Overseas Markets," by Adolph W. Gilbert, Chapman Valve Mfg. Co., Indian Orchard, Mass.

At this session MACHINERY's motion picture, depicting the manufacture of 9.2-inch high-explosive howitzer shells, was shown, accompanied by an explanatory lecture by Chester L. Lucas of MACHINERY's staff.

In connection with the exposition there were interesting exhibits by 160 concerns, among whom were the following:

Bilton Machine Tool Co., Bridgeport, Conn. Gear-cutting machinery, sensitive drill presses, milling machines, and riveting machines.

Cowan Truck Co., Holyoke, Mass. Elevating electric and hand trucks, transportation systems.

Fitchburg Grinding Machine Co., Fitchburg, Mass. Grinding machines.

Peter A. Frasse & Co., Inc., Hartford, Conn. Tubing, steel, tools and supplies.

C. G. Garrigus Machine Co., Bristol, Conn. Machine tools.
General Electric Co., Schenectady, N. Y. Electrical apparatus.

Graton & Knight Mfg. Co., Worcester, Mass. Leather belting, leather specialties.

Greenfield Tap & Die Corporation, Greenfield, Mass. Screw cutting tools and machinery; gages, reamers, etc.

Hampden Corundum Wheel Co., Springfield, Mass. Grinding wheels and polishing abrasives.

Holyoke Truck Co., Holyoke, Mass. Transfer and elevating trucks.

Napier Saw Works, Inc., Springfield, Mass. Metal cutting saws and sawing machines.

National Scale Co., Chicopee Falls, Mass. Counting machines, calling system, elevating trucks, sectional steel shelving.

Noble & Westbrook Mfg. Co., Hartford, Conn. Marking and filing machinery, grinders and buffing lathes, steel dies.

Norton Co., Worcester, Mass. Grinding wheels, grinding machinery.

Norton Grinding Co., Worcester, Mass. Grinding wheels, grinding machinery.

Reed-Prentice Co., Worcester, Mass. Lathes, drilling machines, vertical surface grinding machines.

Springfield Grinding Co., Chester, Mass. Grinding wheels.
L. S. Starrett Co., Athol, Mass. Fine mechanical tools.

Union Twist Drill Co., Athol, Mass. Twist drills, gear and milling cutters.

Van Norman Machine Tool Co., Springfield, Mass. Machine tools, milling machines and grinders.

Walworth Mfg. Co., Boston, Mass. Valves, fittings and tools for steam, water and gas.

Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass. Engine lathes and metal planers.

PYROMETERS OF THE PAST, PRESENT AND FUTURE¹

A REVIEW OF DEVICES FOR MEASURING THE TEMPERATURE OF FURNACES, THEIR LIMITATIONS AND POSSIBLE FUTURE DEVELOPMENTS

AS far as we know, the ancients, who baked excellent bricks and forged iron, measured temperature by a means still used today, but with ever-diminishing success—the eye. But at a very early date attempts were made to measure temperature by the expansion, contraction, or fusing points of clay. Even today the heat of brick and pottery kilns is determined by placing side by side, where they can be seen through a peep-hole, three cones with fusing points, for instance, of 2100, 2120 and 2140 degrees F. When the first cone softens and falls over, it indicates that a temperature of 2100 degrees F. has been attained, and the firing is stopped. If the other cones are still standing, the temperature has not exceeded 2120 degrees F. Unfortunately, though, the cones are affected by both time and temperature, and will soften or fall over at a higher temperature when heated up slowly for 100 hours than when heated to the softening point in an hour or two. They are not suitable for use in heat-treating furnaces for this reason, although attempts have been made to use them. However, some fusible salts have recently been brought out that seem to give reasonably satisfactory results. The capsules containing them are placed on a piece of steel in the furnace and the salts indicate, by melting, when a certain temperature has been attained.

Another of the early devices is the mercurial thermometer, with which everyone is familiar. For temperatures up to 600 degrees F., these have a vacuum above the mercury column. Thermometers graduated above 674 degrees must have the mercury column under pressure to prevent boiling; but 1000 degrees is about the limit for thermometers of this kind.

The first mechanical pyrometers depended on the difference in the expansion of iron and brass for their operation. This form of pyrometer has a tendency to change in its reading with time and temperature, due to the coefficient of expansion of the metals changing through continuous heating and cooling. This occasions frequent readjustments of the pointer to compensate for this error. Another early device was formed by placing a pipe in the furnace, through which water flowed under constant pressure. Thermometers at the inlet and outlet measured the temperature of the water, and the rise in temperature of the water was equivalent to a certain actual temperature in the furnace. The trouble with this device was that leaks occurred which it seemed impossible to prevent. The Siemens water pyrometer is used quite largely by armor-plate manufacturers for heat-treatment. It consists of a copper ball, which is placed on the steel in the furnace and left until it has fully attained the temperature, when it is quickly removed and dropped into a vessel containing a thermometer and a measured quantity of pure water. The rise in temperature of the thermometer in the water is read off in actual temperature degrees on a corresponding scale. An accuracy within about 25 degrees F. is usually attained with this instrument.

There have also been developed a number of pyrometers that compare either a light or different colors with the piece of steel in the furnace. The trouble with all of these is that no two operators get the same results. Resistance thermometers operate on the principle that the electrical resistance of metals changes with the temperature. This instrument is an exceedingly accurate one for measuring low temperatures, but is hardly to be recommended for high temperature service.

Thermo-electric Pyrometers

For measuring temperatures above 1000 degrees F., the thermo-electric method has come to be by far the most largely used. A thermo-electric pyrometer consists of a thermo-couple, a measuring device, and the wires connecting the thermo-couple and the measuring device. If two pieces of wire of different metals are joined at one end and the junction is heated, a small current of electricity will be generated. At

2000 degrees F., a couple formed of iron and copper-nickel wires will generate 50 millivolts. For measuring temperatures up to 200 degrees F., a thermo-couple of bismuth and antimony is best; for temperatures up to 1000 degrees F., a satisfactory thermo-couple consists of one iron wire and one 60 per cent nickel and 40 per cent copper; for temperatures as high as 1800 degrees F., a very satisfactory base-metal thermo-couple is one wire of 90 per cent nickel and 10 per cent chromium and the other wire of 98 per cent nickel and 2 per cent aluminum. For constant service above this, a thermo-couple, one wire of which is chemically pure platinum and the other 90 per cent platinum and 10 per cent rhodium, is recommended.

Thermo-couples of base metal are manufactured with wires from 0.01 inch up to 0.25 inch diameter. Some particular tests require thermo-couple wires of exceedingly small diameter to secure sensitiveness and quick readings. There is no doubt but that heavier wires forming the thermo-couple will increase the life where a base-metal thermo-couple is in constant service at temperatures up to 1600 or 1800 degrees F. While a heavier thermo-couple slightly increases the lag, this is not noticeable in heat-treating furnaces.

If after a base-metal thermo-couple has been used for some time another couple is made from the same wires, the voltage produced might vary as much as 50 degrees at a temperature of 1400 degrees F. Thermo-couples of nickel-chromium wire will vary as much as 30 degrees F., that is, 15 degrees plus or minus, depending on the particular coils from which the wire was cut.

The wires forming a thermo-couple must be insulated from each other throughout their length. A common method is to wrap base-metal thermo-couples with asbestos and paint the asbestos winding with a solution of sodium silicate; another method is to fit lava or porcelain beads over the thermo-couple wire. For the platinum thermo-couple, the insulation must be of porcelain or high-grade fireclay, free from impurities.

The life of a thermo-couple installed in a furnace largely depends on its protecting tube. For temperatures up to 1200 degrees F., a high-grade wrought-iron tube gives satisfactory results. Calorizing, a process recently developed by the General Electric Co., which impregnates the pipe with an aluminum oxide, will increase the life of the pipe about three times when used at temperatures around 1400 degrees F. Tubes of nickel-chromium give excellent results for temperatures as high as 1800 degrees, and they are to be recommended for the protection of base-metal thermo-couples where the temperature exceeds 1200 degrees. Their cost is many times higher than the ordinary wrought-iron pipe and about four times as much as calorized pipe, but their increased life would justify the increased first cost. Platinum thermo-couples must always be protected with a tube that is impervious to gases, such as porcelain, quartz, or alundum.

It is one of the properties of a thermo-couple that the voltage which it generates is dependent on the difference in the temperature of the hot junction and the cold junction, which is the point at which the alloy wires of the thermo-couple join the copper leads of the instrument. It is therefore particularly important that the cold junction be maintained at a constant temperature. In recent years, it has been customary to run compensating leads of the same material as the thermo-couple to a distant point, where the temperature is uniform, instead of having the cold junction just outside the furnace wall, where it might vary several hundred degrees. These compensating leads, in duplex form with asbestos insulation, can be run into a pipe driven into the ground, ten or fifteen feet, where the temperature will remain constant within five degrees, winter or summer. Where it is impossible to place the cold junction in the ground, on account of the furnaces being on an upper floor of a building, a compensation

¹Abstract of a paper by Richard P. Brown, read before the Steel Treating Research Club of Detroit, Mich.

box can be used, consisting of a lamp and thermostat, which will maintain the temperature constant within two degrees.

Measuring Voltage Produced by Thermo-couple

There are two methods of measuring the voltage produced by a thermo-couple, the millivoltmeter method and the potentiometer method. In the former, the instrument consists of a permanent magnet with its pole pieces, in the field of which a copper-wound coil swings in jeweled bearings. The millivoltmeter reads the temperature across the scale and is calibrated in actual temperature degrees. It indicates the temperature from zero to the maximum scale range and relies entirely on the voltage of the thermo-couple for its operation. No outside sources of current are necessary.

In the potentiometer method, the electromotive force produced by the thermo-couple is measured by opposing to it a known variable electromotive force, usually that of a dry cell contained in the instrument, so that when a balance is reached no current flows. A galvanometer is used to indicate the point at which no current is flowing, and the pointer on the galvanometer then indicates zero as the voltage of the thermo-couple is opposed to the dry cell. The advantages of the potentiometer method of measuring temperature are its extreme precision and its independence of resistance changes throughout the thermo-couple circuit. Its disadvantages are that it is not direct reading and some outside source of current is necessary.

Radiation Pyrometers

The radiation pyrometer is a development of the thermo-electric pyrometer. Instead of placing the thermo-couple inside the furnace, where the temperature is so high as to destroy it, it is placed in the back of a tube in front of a mirror. The rays of heat from the furnace enter the tube and, striking the mirror, are brought to a focus on the thermo-couple junction, which attains a heat of only 200 or 300 degrees. It is possible to secure an accuracy within one to two per cent with this instrument, if the instructions for its use are properly carried out. It is not recommended for service where a thermo-electric pyrometer with a base-metal or platinum thermo-couple can be used.

Methods of Standardizing Pyrometers

It is essential, if accurate results are to be secured from pyrometers, that they be restandardized at frequent intervals. The frequency depends on the precision necessary in the work and the equipment available. Some plants check their thermo-couples once a week; it should be done at least once a month. This checking can be satisfactorily accomplished by maintaining a standard platinum thermo-couple and using an electric furnace that is not less than 10 inches deep, so that a base-metal thermo-couple can project at least 6 or 8 inches inside. The base-metal and standard thermo-couples should be tied together with asbestos string with the junctions almost touching each other. Thermo-couples should never be tested in their protecting pipe. A base-metal thermo-couple should not be tested in a furnace with an insertion of less than 6 inches, for the cross-section of the thermo-couple wires is large and they conduct the heat from the furnace. The temperature of an electric furnace should be maintained constant for at least fifteen minutes before a reading is taken, and the tests should preferably be made at the working temperature of the thermo-couple. If the thermo-couple under test reads low and has no adjustable resistance, it must be junked. If it is furnished with a resistance for adjustment purposes, this adjustment can be easily made with a soldering iron.

The freezing point of pure salt is reliable for testing thermo-couples or the complete pyrometer. The thermo-couple should be inserted in a small crucible containing pure salt (ordinary table salt is satisfactory), heated to about 1600 degrees F. and then allowed to cool. At the freezing point of the salt, which will be indicated by the temperature remaining reasonably constant for four or five minutes, the pyrometer should read 1474 degrees. The melting point of a number of metals may also be used. The melting points of the metals most generally used for this purpose are: tin, 450 degrees F.; zinc, 787 degrees; silver, 1761 degrees; and gold, 1945 degrees.

The Future for Pyrometry

It would seem that the greatest development work in temperature-measuring instruments will be in the perfection of optical pyrometers, resistance thermometers, and thermo-electric pyrometers. There is a field for a high-grade optical pyrometer that can be used by any number of operators, all of whom can secure the same results from the instrument. Resistance thermometry will continue to be limited to low temperatures unless some more suitable metal than nickel can be used to form the bulbs. In thermo-electric pyrometry, it is possible to develop better materials for base-metal thermo-couples; the insulation or protecting tube will be difficult to improve upon. The direct-reading millivoltmeter and the potentiometer methods of temperature measurement will doubtless be improved.

However, the greatest future in pyrometry will be along the line of automatic temperature control. There is already an instrument that automatically controls the temperature of an electric furnace, maintaining it constant within 10 degrees F. In connection with this instrument, there are two lights which indicate whether the temperature is high or low. We can place a neutral point, 10 or 20 degrees in width, between the two contact points operating these lights, so that both lights will be out when the temperature is correct and the red or blue light will flash to indicate that the temperature is too high or too low. If a third contact is put in the instrument for this neutral point, it will cause a white light to glow when the temperature is correct. It is much easier to instruct a fireman to keep the white light burning and the other lights out than to get him to maintain 1380 degrees on the pyrometer. He can see the lights from some distance, and these are easily understood by him. It is only a question of time when a switching device will permit one instrument to operate the signal lights at a number of furnaces.

One of the greatest difficulties experienced by pyrometer manufacturers is to induce the user of these instruments to install them properly. Frequently this is left to someone who has absolutely no knowledge of pyrometers, and the instructions of the manufacturer are not carried out in a satisfactory manner. Recently, the service man of one pyrometer company found pyrometer equipment giving incorrect readings because it had been wired up throughout with small diameter uninsulated iron wire.

* * *

MILLING AND GRINDING

The use of milling machines and grinding machines has increased greatly during the past ten years; and these machines are now regarded generally as standard machine tool equipment. There is little question of the superiority of the milling machine over the planer or shaper for manufacturing parts in large quantities. Nor can the place of the grinding machine as a follower of the lathe for finishing cylindrical surfaces be longer denied. But notwithstanding the great increase in the use of these machine tools, the lathe is still the recognized leader of all. More lathes are built and sold than any other machine tool except drilling machines. Planers have their place in the machine shop and will always be used for jobbing and repair work and probably for planing the working surfaces of machines that must be highly accurate. The shaper and slotter have their recognized places also. The point to be made is that the development of any type of machine tool does not necessarily, if ever, result in displacing another; it may, in fact, make a broader and better market for all.

* * *

FOUNDRY AND MACHINE SHOP EQUIPMENT AND SUPPLIES EXHIBIT

The twelfth annual exhibit of foundry and machine shop equipment and supplies will be held in the Mechanics Bldg., Boston, Mass., under the auspices of the American Foundrymen's Association, September 25 to 28, inclusive. Copies of the rules and regulations may be obtained from C. E. Hoyt, manager of exhibits, 123 W. Madison St., Chicago, Ill.

MACHINE-CUT ELLIPTICAL GEARS¹

LAYING OUT AND MACHINING ELLIPTIC AND OVAL GEARS

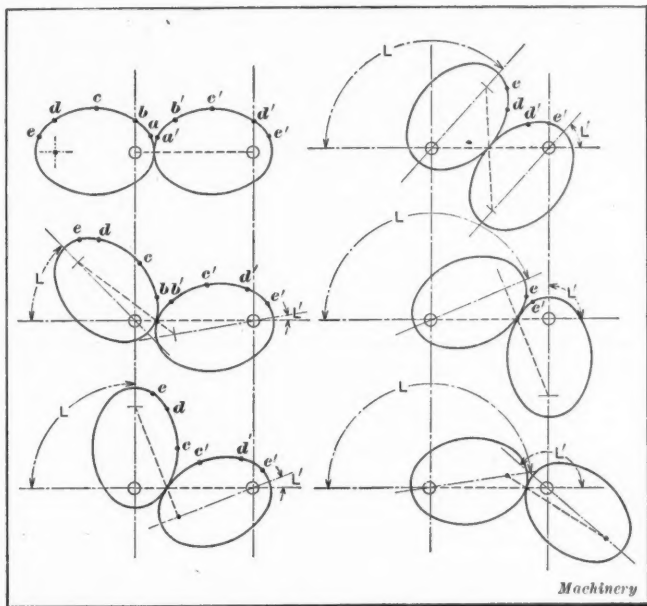
BY REGINALD TRAUTSCHOLD²

Fig. 1. Rolling Contact of Ellipses with Bore at Focus

THE correct proportioning of elliptic or elliptical gearing presents one of the most intricate problems confronting the gear designer, but, fortunately, it need not present the same difficulties to the machinist if the work is correctly laid out for him in the drafting-room. To cut elliptic gears successfully requires a high degree of skill and careful workmanship on the part of the machine operator, but the real problem is one of design. This is fortunate, for it permits the derivation of reliable formulas which, though they necessitate considerable accurate figuring on the part of the designer, greatly simplify the calculations and enable the problem to be put to the operator as a definite and concrete task: one that requires, in its execution, simply careful workmanship and proper attention to the adjustments of a comparatively simple fixture.

Elliptic gearing furnishes a comparatively cheap, efficient and positive mechanism for imparting a quick-return motion to the ram of shapers, planers and a large variety of machine tools. The variation in speed of these gears is from a maxi-

¹ For previous articles on the design of gearing, see "Epicyclic Gear Trains" in the July, 1917, number of MACHINERY, and articles there referred to.
² Address: 39 Charles St., New York City.

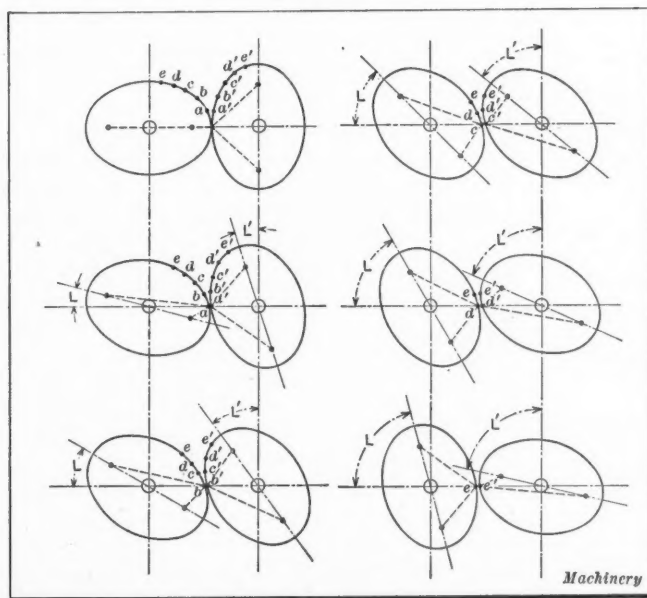


Fig. 2. Non-contact of Ellipses with Bore at Center

mum to a minimum, the bore being located at one of the foci of the ellipse. So-called "elliptical" gears with the bore at the center of the gear are also employed. These have not a true elliptic outline, but their circumference is appreciably greater than is that of a true ellipse of similar major and minor axes. To differentiate it from the one of true elliptic outline, this second variety of gear may be arbitrarily designated as an "oval gear"; while the term elliptic gear may be taken to designate a gear of true elliptic form.

The rolling actions of the two forms of mountings, those with the bore at the foci and those with the bore at the center, are depicted in Figs. 1 and 2. In the case of ellipses with the bore at one of the foci, any point on the circumference of one of the ellipses, a, b, c, d, e , will be in contact with any similarly located point on the circumference of the other ellipse, a', b', c', d', e' , in the plane of the bores and a line connecting the stationary foci of the two ellipses will lie in this plane and intersect a plane tangent to both ellipses at the point of contact. In the case of the ellipses with the bore at the center, points on the circumference of one of the ellipses, a, b, c, d, e , will not be in contact with similarly located points on the circumference of the other ellipse, a', b', c', d', e' , on the bore plane, the centers of the bores being fixed as in the other instance, but will be separated by an amount depending on the

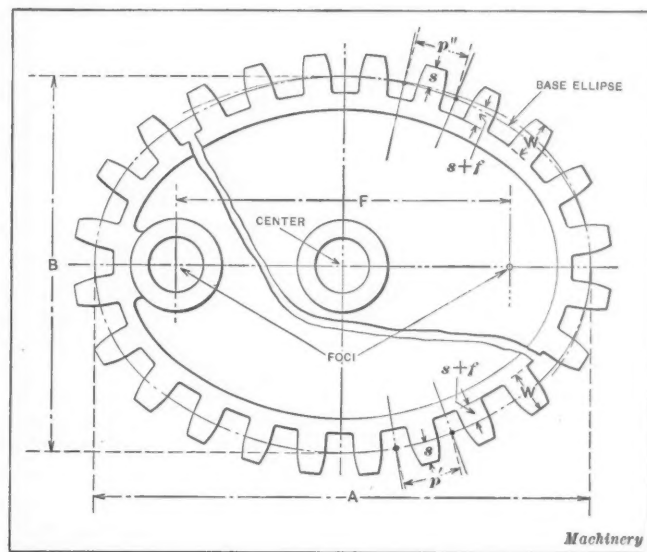


Fig. 3. Elliptic and Oval Gear Diagrams

proportions of the ellipses. Only when the major and minor axes of the ellipses are at right angles can the ellipses be in intimate contact. To secure contact at all points, the elliptic outlines must be increased by an increment that will fill in the gap between the ellipses; and in order that the two figures may be similar in outline, the increment should be the same for each ellipse.

The similarity between elliptic and oval gears lies only in the fact that they are both developed from ellipses. In one case the ellipse is the final outline; and in the other, the ellipse has to be modified by an increase in the length of curve included between the two axes' planes in each of the four quadrants. The lengths of the axes are not changed, nor should the degree of curvature at points of contact be altered; the variation in curvature is simply limited to sections between the required points of contact. Elliptic and oval gear sections are illustrated in Fig. 3 in a manner that brings out their similarity in general appearance as well as their difference in pitch outlines.

The Ellipse

The basic form of either the elliptic or the oval gear is the ellipse, so the characteristics of this figure should be clearly

understood before taking up the derivation of working formulas. An ellipse is shown in Fig. 4. Its governing peculiarity is that the sum of the distances of any point P on the circumference from the two foci is constant, and the normal passing through such point bisects the angle included between lines drawn from the point to the foci. The angle between the tangent to the point and one of the axes of the ellipse is equal to the angle between the normal to the point and the other axis of the ellipse. The distance between the two foci, the "focus distance," is equal to the square root of the difference of the squares of the major and minor axes. These definite relations establish the equation of the ellipse, which, though simple, necessitates an application of analytical geometry and calculus to establish the location of any particular point on the circumference, the angularity of tangents, etc. This involves much calculation that, from a practical point of view, is quite unnecessary.

The curvature of an ellipse really decreases in each quadrant, from the major to the minor axis, but for all practical purposes, there are but two degrees of curvature in each quadrant of any elliptic gear encountered in practice, or that is capable of practical use, so that a close approximation of a true ellipse may be drawn with circular arcs of but two radii. These radii, which, for convenience, will be designated as major and minor, are equal to the major axis minus one-half the minor axis and to three-quarters the minor axis minus one-quarter the major axis. The first is the radius of the curve straddling the minor axis, and the second is the radius of the curve straddling the major axis. In workable ellipses, such curves become tangent to each other at definite points, so that the length of the major-radius curve is an arc included by an angle of 73 degrees, 44 minutes, as shown in Fig. 4, and the minor-radius curve is an arc included by an angle of 106 degrees, 16 minutes. These angles may be arbitrarily taken as the same for all ellipses, irrespective of the axes' lengths.

Dimensions Required by the Machinist

Fig. 5 depicts the method of cutting both elliptic and oval gears, the rotary cutter being tangent to the pitch line at mid-tooth space. The angle of tangency, the angle included between the center line of the rotary cutter and the major axis, is the same for either type of gear, but the location of the bore in respect to the center line of the cutter differs. If the outlines of the two varieties of gears were similar, the difference in both vertical and horizontal coordinates would be controlled by the distance from the focus to the center of the gear. In fact, much of the trouble encountered in cutting oval gears with the bore at the center comes from just this particular point. Oval gears with the bore at the center are not elliptic in outline and cannot be successfully cut with settings that would be satisfactory were it not necessary to modify the elliptic form in order that the gears may roll together in intimate contact.

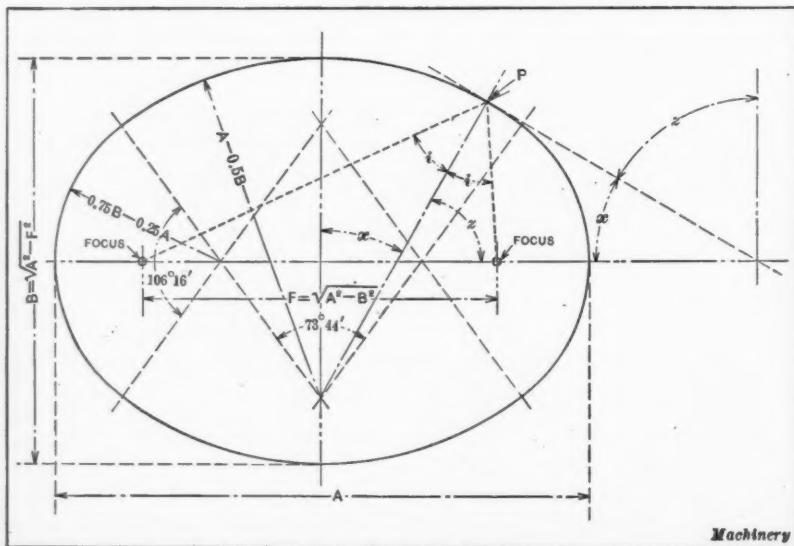


Fig. 4. The Ellipse

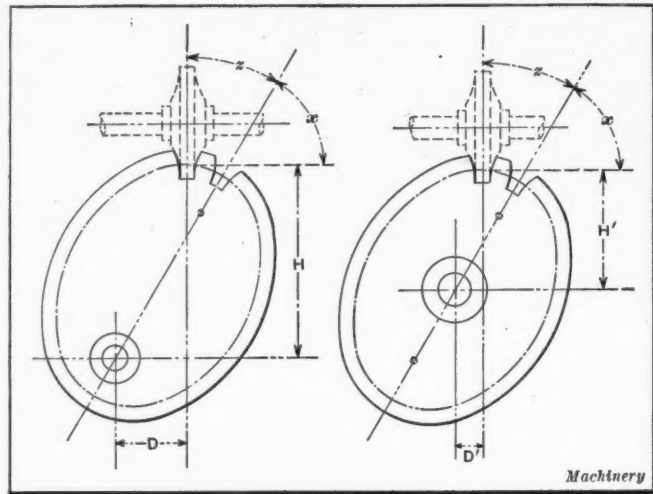


Fig. 5. Machining Elliptic and Oval Gears

Laying Out Elliptic Gears

The elliptic gear is the simpler variety to design, as an oval gear must first be proportioned as if it were truly elliptic in outline and then modified by the necessary increments. Both varieties are frequently laid out to a suitable scale and the required dimensions scaled; the "lay-out method" and a certain dependence on graphic depiction is a material aid even when employing the more accurate method of calculation of the necessary angles and dimensions.

The pitch outline of an elliptic gear is shown in Fig. 6. This may be drawn by the common "gardener's ellipse" method or by the use of the circular arcs, as has been described. The pitch circumference is then divided into as many equal sections as there are teeth in the gear, the points of division locating the centers of the tooth spaces. Preferably, the number of teeth in an elliptic gear should be odd, so that a tooth space at one end of the gear is opposite a tooth at the other end, thereby permitting both gears of a pair to be identical. If the number of teeth is even, a double set of calculations becomes necessary, as the tooth spaces of one of a pair must coincide with the teeth of the mating gear.

The coordinates of the center of the tooth spaces, with reference to the stationary focus, are readily calculated for an ellipse laid out with circular arcs, and are, for all practical purposes, the same as those of similar points about a true ellipse. The distance of each tooth-space center from the stationary focus is then readily obtained, as it is the length of the hypotenuse of a right-angle triangle having for its other sides the coordinates of the tooth-space center with respect to the stationary focus. These coordinate dimensions are the horizontal and vertical settings required by the machinist, and the angular setting of the blank is the angle included between the tangent at mid-tooth space and the major axis of the ellipse.

Laying Out Oval Gears

Oval gears should have an even number of teeth, so that but one set of calculations is necessary, and the teeth should be arranged so that they do not come on the axis of the ellipse, but so that the transverse pitch line on the profile of a tooth falls on the axes of the gear, as shown in Fig. 7. This illustration depicts the basic oval outline of the gear, not its final pitch outline.

The coordinates of the tooth-space centers, with reference to the center of the gear, are found in a manner similar to that employed for elliptic gears. The distance of each tooth-space center from the center of the gear on the base ellipse is then found and normals through each of the tooth-space centers are drawn. The horizontal setting D' is found directly from the triangle formed by the line connecting the center tooth space on the ellipse and the rectangular

coordinates of such point about the center of the gear. The ordinate of the point is also calculated, though it is not equal to the vertical setting, which is controlled by the amount of increment added to the ellipse at each tooth space.

The distance between shafts of mating oval gears is constant and equal to one-half the sum of the major and minor axes of the gear, so that if the sum of the distances from the tooth-space center of conjugate tooth spaces is made equal to the distance between shafts, constant contact is secured. The proper total increment required in order to secure such intimate contact between mating gears is the difference between the sum of the distances of center tooth points on the ellipse of conjugate tooth spaces and the distance between the shafts of the respective gears. Half of this total increment added to each gear will keep the gears similar in outline. The increment is not added to the oval outline normally, but so that the distance from the pitch center of the tooth space on the mid-tooth space normal to the center of the gear is equal to the distance from the center of the gear to the center of the tooth space on the ellipse, plus half the total increment required for intimate contact, see Fig. 8. A smooth curve passing through the points thus located on the tooth space normals gives the required pitch outline of the gear. To this must be added, in the gear blank, sufficient metal to accommodate the addendum of the teeth, etc. The correct vertical setting is then obtained by direct proportion, the same relationship existing between the distance of the mid-tooth space point on the ellipse and this same dimension plus the necessary increment as exists between the ordinate of the center tooth space on the ellipse and the correct vertical setting.

Notation for Elliptical Gearing

Major axis (pitch).....	A
Minor axis (pitch).....	B
Focus distance, distance between foci.....	F
Pitch circumference of ellipse.....	C
Quick-return ratio of elliptic gears.....	R
Number of teeth.....	N
Circular pitch of elliptic gears.....	p'
Major radius for ellipse.....	r'
Minor radius for ellipse.....	r''
Angular pitch of major radius segment.....	a
Angular pitch of minor radius segment.....	a'
Angle included between tooth-space tangents and major axis.....	x
Angularity of ratchet index.....	z
Ordinate of tooth-space center on ellipse.....	h'
Abscissa of tooth-space center on ellipse.....	v'
Distance between tooth-space center on ellipse and focus axis.....	Y
Angle included between Y and major axis.....	y
Angle included between Y and tooth-space tangent.....	w
Vertical setting for machining fixture.....	H
Horizontal setting for machining fixture.....	D
Effective circular pitch of oval gears.....	p''
Distance between tooth-space center on ellipse and gear center.....	Y''
Sum of conjugate Y''.....	X
Correction increment.....	j
Distance between tooth-space pitch center and gear center.....	Y'
Angle included between Y'' and major axis.....	y'
Angle included between Y'' and tooth-space tangent.....	w'
Vertical setting on ellipse.....	H''
Vertical setting for machining fixture.....	H'
Horizontal setting for machining fixture.....	D'

Formulas for Elliptic and Oval Gears

$$B = \sqrt{A^2 - F^2} \quad (1) \quad F = \frac{A(R-1)}{R+1} \quad (2)$$

$$R = \frac{A+F}{A-F} \quad (3) \quad r' = A - 0.5B \quad (4)$$

$$r'' = 0.75B - 0.25A \quad (5) \quad C = 1.6464A + 1.4952B \quad (6)$$

$$p' = \frac{C}{N} \quad (7) \quad a = \frac{57.295p'}{r'} \quad (8) \quad a' = \frac{57.295p'}{r''} \quad (9)$$

$$h' = r'' \sin z \quad (\text{in minor-radius segments}) \quad (10)$$

$$h' = r' \cos x - r' + 0.5B \quad (\text{in major-radius segments}) \quad (10a)$$

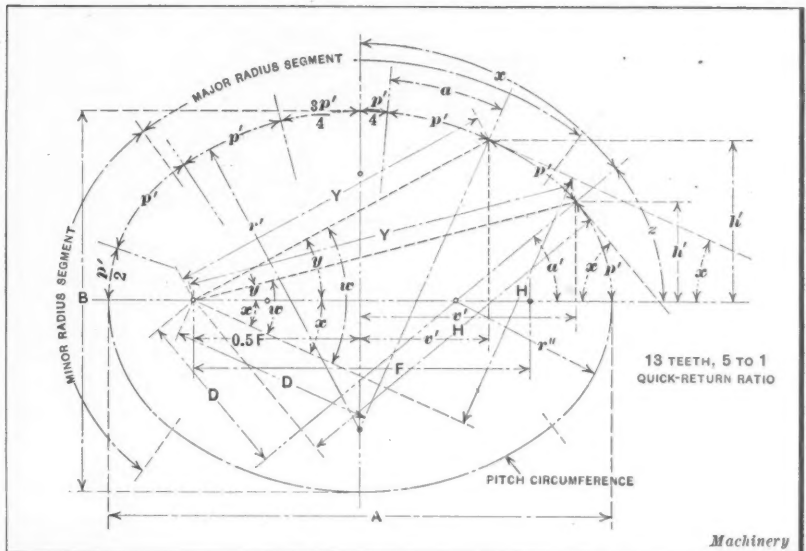


Fig. 6. Elliptic Gear Diagram

$$v' = r'' \cos z + 0.5A - r'' \quad (\text{in minor-radius segments}) \quad (11)$$

$$v' = r' \sin x \quad (\text{in major-radius segments}) \quad (11a)$$

$$Y = \sqrt{h'^2 + (\pm 0.5F \pm v')^2} \quad (12) \quad \tan y = \frac{h'}{\pm 0.5F \pm v'} \quad (13)$$

$$w = y \pm x \quad (14) \quad H = Y \sin w \quad (15)$$

$$D = Y \cos w \quad (16) \quad p'' = \frac{C}{N} \quad (17)$$

$$Y'' = \sqrt{h'^2 + v'^2} \quad (18) \quad j = 0.5(0.5A + 0.5B - X) \quad (19)$$

$$Y' = Y'' + j \quad (20) \quad \tan y' = \frac{h'}{v'} \quad (21) \quad w' = y' + x \quad (22)$$

$$H'' = r'' + (0.5A - r'') \cos (90 - x) \quad (\text{in minor-radius segments}) \quad (23)$$

$$H'' = Y'' \sin w' \quad (\text{in major-radius segments}) \quad (23a)$$

$$H' = \frac{H'' Y'}{Y''} \quad (24)$$

$$D' = (0.5A - r'') \sin (90 - x) \quad (\text{in minor-radius segments}) \quad (25)$$

$$D' = Y'' \cos w' \quad (\text{in major-radius segments}) \quad (25a)$$

Discussion of Formulas

The relationships existing between the major axis, the minor axis, and the focus distance are the ordinary characteristics common to the ellipse. The quick-return ratio of elliptic gears is the ratio between the maximum and minimum distances of the pitch circumference from the stationary, or bore, focus. No such ratio exists for oval gears, as the distance between the shafts of the gears with the central bore is equal to half the sum of the major and the minor axes. Two speed changes occur during a complete revolution of the gears in such an arrangement; one is measured by the ratio of the major axis to the minor axis, and the other by the ratio of the minor axis to the major axis.

The major and minor radii of the ellipse are the radii of circular arcs straddling the minor and the major axes, respectively; the former contains 73 degrees, 44 minutes, and the latter 106 degrees, 16 minutes. The sum of the lengths of the two major-radius segments and the two minor-radius segments equals the circumference of the ellipse. This divided by the number of teeth gives the circular pitch for elliptic gears.

The circular pitch multiplied by 360 degrees and the product divided by the circumference of a circle having a radius equal to the major radius of the ellipse gives the angular pitch in the major-radius segments. The same product divided by the circumference of a circle having a radius equal to the minor radius of the ellipse gives the angular pitch in the minor-radius segments.

To obtain the ordinate of the tooth-space center on the pitch ellipse necessitates two formulas: one for cases where the tooth-space center falls within the minor-radius segments, and

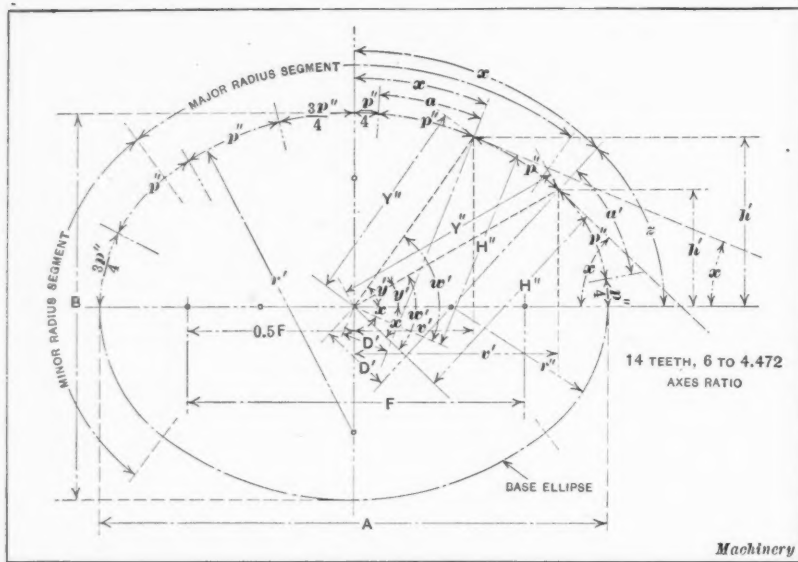


Fig. 7. Base Ellipse for Oval Gear

the other for points that fall within the major-radius segments. In the former, the ordinates are equal to the minor radius times the sine of the angle included between the normal passing through the tooth-space center and the major axis. Within the major-radius segments, the ordinates are measured by the product of the major radius and the cosine of the angle included between the normal passing through the tooth-space center and the minor axis, minus the difference between the major radius and one-half the minor axis. This value, by which the product of the major radius and the cosine of the angle is reduced, is the distance from the major axis to the center of the major radius.

The abscissa of the tooth-space center on the pitch ellipse is found in a similar manner, two formulas being required. For centers within the minor-radius segments, the abscissas are equal to the product of the minor radius and the cosine of the angle included between the normal passing through the tooth-space center and the major axes, plus the difference between half the major axis and the minor radius. Within the major-radius segments, the abscissas are equal to the major radius multiplied by the sine of the angle included between the normal passing through the tooth-space center and the minor axis.

The distance between the tooth-space center on the ellipse and the stationary focus in elliptic gears is equal to the square root of the sum of the square of the ordinate plus the square of the distance of the projected center on the major axis from the stationary focus. When the projection of the center on the major axis falls on the farther side of the minor axis from that on which the stationary focus is located, this distance is equal to one-half the focus distance plus the abscissa; when between the near center of the minor radius and the minor axis, it is equal to the focus distance minus the abscissa; and when between the near minor radius center and the near end of the major axis, it is equal to the abscissa minus half the focus distance.

The tangent of the angle included between Y and the major axis is equal to the ordinate of the tooth-space center divided by the distance of the projected center on the major axis from the stationary focus. This angle plus or minus the angle included between the tangent to the tooth-space center and the major axis equals the angle included between Y and the tooth-space tangent. When the tooth-space center lies on the far side of the minor axis, the angle included between Y and the tooth-space tangent is the sum of the two smaller angles; when on the near side, it is equal to the difference of the two angles.

The vertical setting for the machining fixture, the distance between the plane of the rotary cutter and a parallel plane passing through the stationary

focus of the gear, is equal to the distance between the tooth-space center and the stationary focus multiplied by the sine of the angle included between Y and the tooth-space tangent; while the horizontal setting for the machining fixture is equal to the product of this same dimension by the cosine of the angle.

The effective circular pitch of oval gears corresponds to the circular pitch of elliptic gears and is found in the same manner; namely, by dividing the pitch circumference of the base ellipse by the number of teeth in the gear.

The distance between the center of the tooth space on the ellipse and the central bore of the gear is equal to the square root of the sum of the squares of the ordinate and abscissa dimensions of the tooth-space center on the base ellipse.

The correction increment is equal to half the sum of the major and minor axes of the gear, minus the sum of the distances of conjugate tooth-space centers on the base ellipse from the center of the gear divided by 2. Conjugate tooth spaces are a tooth space on one gear and the space opposite the tooth on the mating gear that will engage the tooth space on the first gear. For instance, in a pair of mating oval gears with fourteen teeth, the conjugate tooth space of the first tooth space on the driving gear is the fourth tooth space on the driven gear, counting tooth spaces from similar points on the two gears. Similarly, the conjugate tooth space for the second tooth space on the driver is the third on the driven gear, and for the remainder of the tooth spaces the conjugates are the third and second, fourth and first, fifth and fourteenth, sixth and thirteenth, seventh and twelfth, eighth and eleventh, ninth and tenth, tenth and ninth, and so forth.

The correction increment added to the distance between the tooth-space center on the base ellipse and the central bore gives the distance of the actual pitch center of the tooth space from the center of the gear.

The tangent of the angle included between the line connecting the tooth-space center on the base ellipse with the center of the gear and the major axis is equal to the ordinate dimension of the point on the base ellipse divided by its abscissa dimension. This angle plus the angle included between the tooth-space normal and the minor axis (the complement of the angle included between the tooth-space normal and the major axis) equals the angle included between Y'' and the tooth-space tangent on the base ellipse.

The vertical setting on the base ellipse, when the normal of the tooth space crosses the minor-radius segment of the base ellipse, is equal to the minor radius plus the product of the cosine of the complement of the angle included between the

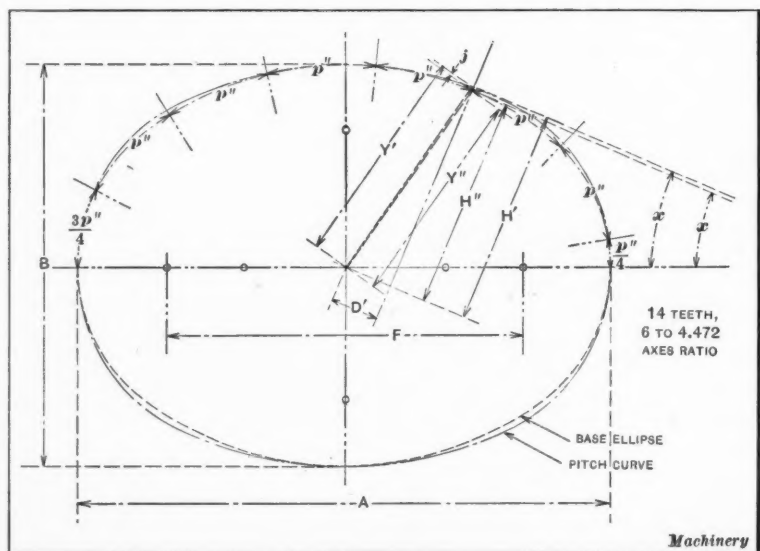


Fig. 8. Oval Gear Diagram

tooth-space tangent and the major axis by the difference between half the major axis and the minor radius of the base ellipse. When the tooth-space normal crosses the major-radius segment, the vertical setting on the base ellipse is equal to the product of Y'' by the sine of the angle included between Y'' and the tooth-space tangent.

The vertical setting on the base ellipse multiplied by the quotient of Y' divided by Y'' equals the vertical setting for the machining fixture. This dimension is the distance between a tangent to the pitch curve at the tooth-space normal and a parallel line passing through the central bore of the gear.

The horizontal setting for the machining fixture, in minor-radius segments, is equal to the product of the sine of the complement of the angle included between the tooth-space tangent and the major axis by the difference between half the major axis and the minor radius of the base ellipse. The horizontal setting for tooth spaces crossing the major-radius segment is equal to the product of Y'' by the cosine of the angle included between Y'' and the tooth-space tangent. For tooth spaces lying to the right of the gear center, the horizontal settings are also measured to the right; and for tooth spaces lying to the left of the gear center, the horizontal settings are in the same direction.

Example 1—Required, a pair of elliptic gears; 6-inch centers, 5 to 1 quick-return motion, 13 teeth; bore at focus.

$$F = \frac{6(5-1)}{5+1} = 4 \text{ inches} \quad (2)$$

$$B = \sqrt{36-16} = 4.472 \text{ inches} \quad (1)$$

$$C = 1.6464 \times 6 + 1.4952 \times 4.472 = 16.5649 \text{ inches} \quad (6)$$

$$p' = \frac{16.5649}{13} = 1.2742 \text{ inch} \quad (7)$$

$$r' = 6 - 0.5 \times 4.472 = 3.764 \text{ inches} \quad (4)$$

$$r'' = 0.75 \times 4.472 - 0.25 \times 6 = 1.854 \text{ inch} \quad (5)$$

$$a = \frac{57.295 \times 1.2742}{3.764} = 19.396 \text{ degrees} \quad (8)$$

$$a' = \frac{57.295 \times 1.2742}{1.854} = 39.377 \text{ degrees} \quad (9)$$

Tooth-space Number	x, Degrees	z, Degrees	Tooth-space Number	x, Degrees	z, Degrees
1	90.000	0.000	8	70.312	199.688
2	50.623	39.377	9	33.943	236.057
3	24.245	65.755	10	14.547	255.453
4	4.849	85.151	11	4.849	274.849
5	14.547	104.547	12	24.245	294.245
6	33.943	123.943	13	50.623	320.623
7	70.312	160.312			

Tooth-space Number	h', inches
1	h' = 0.000 inch
2	h' = 1.854 × 0.63451 = 1.175 inch (10)
3	h' = 3.764 × 0.91176 = 1.528 = 1.902 inch (10a)
4	h' = 3.764 × 0.99642 = 1.528 = 2.227 inches (10a)
5	h' = 3.764 × 0.96793 = 1.528 = 2.114 inches (10a)
6	h' = 3.764 × 0.82960 = 1.528 = 1.592 inch (10a)
7	h' = 1.854 × 0.33682 = 0.625 inch (10)
8	h' = 0.625 inch
9	h' = 1.592 inch
10	h' = 2.114 inches
11	h' = 2.227 inches
12	h' = 1.902 inch
13	h' = 1.175 inch

Tooth-space Number	v', inches
1	v' = 3.000 inches
2	v' = 1.854 × 0.77292 + 1.146 = 2.578 inches (11)
3	v' = 3.764 × 0.41072 = 1.549 inch (11a)
4	v' = 3.764 × 0.08455 = 0.318 inch (11a)
5	v' = 3.764 × 0.25122 = 0.947 inch (11a)
6	v' = 3.764 × 0.55830 = 2.106 inches (11a)
7	v' = 1.854 × 0.94157 + 1.146 = 2.890 inches (11)
8	v' = 2.890 inches
9	v' = 2.106 inches
10	v' = 0.947 inch
11	v' = 0.318 inch
12	v' = 1.549 inch
13	v' = 2.578 inches

Tooth-space Number	Y, inches
1	Y = 0.5 × 4 + 0.5 × 6 = 5.00 inches
2	Y = √(1.175)² + (2 + 2.578)² = 4.72 inches (12)

$$3 \quad Y = \sqrt{(1.902)^2 + (2 + 1.549)^2} = 4.03 \text{ inches} \quad (12)$$

$$4 \quad Y = \sqrt{(2.227)^2 + (2 + 0.318)^2} = 3.22 \text{ inches} \quad (12)$$

$$5 \quad Y = \sqrt{(2.114)^2 + (2 - 0.947)^2} = 2.32 \text{ inches} \quad (12)$$

$$6 \quad Y = \sqrt{(1.592)^2 + (2.106 - 2)^2} = 1.60 \text{ inch} \quad (12)$$

$$7 \quad Y = \sqrt{(0.625)^2 + (2.890 - 2)^2} = 1.09 \text{ inch} \quad (12)$$

$$8 \quad Y = 1.09 \text{ inch}$$

$$9 \quad Y = 1.60 \text{ inch}$$

$$10 \quad Y = 2.32 \text{ inches}$$

$$11 \quad Y = 3.22 \text{ inches}$$

$$12 \quad Y = 4.03 \text{ inches}$$

$$13 \quad Y = 4.72 \text{ inches}$$

Tooth-space Number

$$1 \quad \tan y = 0.000; \quad y = 0.000 \text{ degrees} \quad (13)$$

$$2 \quad \tan y = \frac{1.175}{2 + 2.578} = 0.257; \quad y = 14.416 \text{ degrees} \quad (13)$$

$$3 \quad \tan y = \frac{1.902}{2 + 1.549} = 0.536; \quad y = 28.199 \text{ degrees} \quad (13)$$

$$4 \quad \tan y = \frac{2.227}{2 + 0.318} = 0.962; \quad y = 43.883 \text{ degrees} \quad (13)$$

$$5 \quad \tan y = \frac{2.114}{2 - 0.947} = 2.007; \quad y = 63.516 \text{ degrees} \quad (13)$$

$$6 \quad \tan y = \frac{1.592}{2.106 - 2} = 15.03; \quad y = 86.200 \text{ degrees} \quad (13)$$

$$7 \quad \tan y = \frac{0.625}{2.890 - 2} = 0.703; \quad y = 35.1 + 90 \text{ degrees} = 125.100 \text{ degrees} \quad (13)$$

$$8 \quad y = 125.100 \text{ degrees}$$

$$9 \quad y = 86.200 \text{ degrees}$$

$$10 \quad y = 63.516 \text{ degrees}$$

$$11 \quad y = 43.883 \text{ degrees}$$

$$12 \quad y = 28.199 \text{ degrees}$$

$$13 \quad y = 14.416 \text{ degrees}$$

Tooth-space Number

$$1 \quad w = 0 + 90 = 90.000 \text{ degrees} \quad (14)$$

$$2 \quad w = 14.416 + 50.623 = 65.039 \text{ degrees} \quad (14)$$

$$3 \quad w = 28.199 + 24.245 = 52.444 \text{ degrees} \quad (14)$$

$$4 \quad w = 43.883 + 4.849 = 48.732 \text{ degrees} \quad (14)$$

$$5 \quad w = 63.516 - 14.547 = 48.969 \text{ degrees} \quad (14)$$

$$6 \quad w = 86.200 - 33.943 = 52.257 \text{ degrees} \quad (14)$$

$$7 \quad w = 35.100 + 70.312 = 105.412 \text{ degrees} \quad (14)$$

$$8 \quad w = 105.412 \text{ degrees}$$

$$9 \quad w = 52.257 \text{ degrees}$$

$$10 \quad w = 48.969 \text{ degrees}$$

$$11 \quad w = 48.732 \text{ degrees}$$

$$12 \quad w = 52.444 \text{ degrees}$$

$$13 \quad w = 65.039 \text{ degrees}$$

Tooth-space Number

$$1 \quad H = 5 \times 1 = 5.000 \text{ inches} \quad (15)$$

$$2 \quad H = 4.72 \times 0.90659 = 4.275 \text{ inches} \quad (15)$$

$$3 \quad H = 4.03 \times 0.79276 = 3.190 \text{ inches} \quad (15)$$

$$4 \quad H = 3.22 \times 0.75165 = 2.420 \text{ inches} \quad (15)$$

$$5 \quad H = 2.32 \times 0.75433 = 1.750 \text{ inch} \quad (15)$$

$$6 \quad H = 1.60 \times 0.79076 = 1.265 \text{ inch} \quad (15)$$

$$7 \quad H = 1.09 \times 0.96402 = 1.050 \text{ inch} \quad (15)$$

$$8 \quad H = 1.050 \text{ inch}$$

$$9 \quad H = 1.265 \text{ inch}$$

$$10 \quad H = 1.750 \text{ inch}$$

$$11 \quad H = 2.420 \text{ inches}$$

$$12 \quad H = 3.190 \text{ inches}$$

$$13 \quad H = 4.275 \text{ inches}$$

Tooth-space Number

$$1 \quad D = 5 \times 0 = 0 \quad (16)$$

$$2 \quad D = 4.72 \times 0.42192 = 1.99 \text{ inch} \quad (16)$$

$$3 \quad D = 4.03 \times 0.60960 = 2.456 \text{ inches} \quad (16)$$

$$4 \quad D = 3.22 \times 0.65956 = 2.123 \text{ inches} \quad (16)$$

$$5 \quad D = 2.32 \times 0.65650 = 1.523 \text{ inch} \quad (16)$$

$$6 \quad D = 1.60 \times 0.61213 = 0.980 \text{ inch} \quad (16)$$

$$7 \quad D = 1.09 \times 0.26584 = 0.290 \text{ inch} \quad (16)$$

$$8 \quad D = 0.290 \text{ inch}$$

$$9 \quad D = 0.980 \text{ inch}$$

$$10 \quad D = 1.523 \text{ inch}$$

$$11 \quad D = 2.123 \text{ inches}$$

$$12 \quad D = 2.456 \text{ inches}$$

$$13 \quad D = 1.990 \text{ inch}$$

Example 2—Required, a pair of oval gears; major axis, 6 inches; focus distance, 4 inches; 14 teeth; bore at center of gear.

$$B = \sqrt{36 - 16} = 4.472 \text{ inches} \quad (1)$$

$$C = 1.6464 \times 6 + 1.4952 \times 4.472 = 16.5649 \text{ inches} \quad (6)$$

$$p'' = \frac{16.5649}{14} = 1.1832 \text{ inch} \quad (17)$$

$$r'' = 6 - 0.5 \times 4.472 = 3.764 \text{ inches} \quad (4)$$

$$r'' = 0.75 \times 4.472 - 0.25 \times 6 = 1.854 \text{ inch} \quad (5)$$

$$a = \frac{57.295 \times 1.1832}{3.764} = 18.010 \text{ degrees} \quad (8)$$

$$a' = \frac{57.295 \times 1.1832}{1.854} = 36.565 \text{ degrees} \quad (9)$$

Tooth-space Number	x, Degrees	z, Degrees	Tooth-space Number	x, Degrees	z, Degrees
1	80.859	9.141	8	80.859	189.141
2	44.294	45.706	9	44.294	225.706
3	22.512	67.488	10	22.512	247.488
4	4.502	85.498	11	4.502	265.498
5	13.508	103.508	12	13.508	283.508
6	31.518	121.518	13	31.518	301.518
7	62.576	152.576	14	62.576	332.576

Tooth-space Number	h', inches
1	$h' = 1.854 \times 0.15888 = 0.294 \text{ inch}$
2	$h' = 1.854 \times 0.71569 = 1.327 \text{ inch}$
3	$h' = 3.764 \times 0.92377 = 1.528 = 1.952 \text{ inch}$
4	$h' = 3.764 \times 0.99692 = 1.528 = 2.232 \text{ inches}$
5	$h' = 3.764 \times 0.97234 = 1.528 = 2.132 \text{ inches}$
6	$h' = 3.764 \times 0.85249 = 1.528 = 1.682 \text{ inch}$
7	$h' = 1.854 \times 0.46046 = 0.853 \text{ inch}$
8	$h' = 0.294 \text{ inch}$
9	$h' = 1.327 \text{ inch}$
10	$h' = 1.952 \text{ inch}$
11	$h' = 2.232 \text{ inches}$
12	$h' = 2.132 \text{ inches}$
13	$h' = 1.682 \text{ inch}$
14	$h' = 0.853 \text{ inch}$

Tooth-space Number	v', inches
1	$v' = 1.854 \times 0.98730 + 1.146 = 2.978 \text{ inches}$
2	$v' = 1.854 \times 0.69842 + 1.146 = 2.442 \text{ inches}$
3	$v' = 3.764 \times 0.38295 = 1.442 \text{ inch}$
4	$v' = 3.764 \times 0.07846 = 0.295 \text{ inch}$
5	$v' = 3.764 \times 0.23359 = 0.879 \text{ inch}$
6	$v' = 3.764 \times 0.52275 = 1.970 \text{ inch}$
7	$v' = 1.854 \times 0.88761 + 1.146 = 2.791 \text{ inches}$
8	$v' = 2.978 \text{ inches}$
9	$v' = 2.442 \text{ inches}$
10	$v' = 1.442 \text{ inch}$
11	$v' = 0.295 \text{ inch}$
12	$v' = 0.879 \text{ inch}$
13	$v' = 1.970 \text{ inch}$
14	$v' = 2.791 \text{ inches}$

Tooth-space Number	Y'', inches
1	$Y'' = \sqrt{(0.294)^2 + (2.978)^2} = 2.99 \text{ inches}$
2	$Y'' = \sqrt{(1.327)^2 + (2.442)^2} = 2.78 \text{ inches}$
3	$Y'' = \sqrt{(1.952)^2 + (1.442)^2} = 2.43 \text{ inches}$
4	$Y'' = \sqrt{(2.232)^2 + (0.295)^2} = 2.25 \text{ inches}$
5	$Y'' = \sqrt{(2.132)^2 + (0.879)^2} = 2.31 \text{ inches}$
6	$Y'' = \sqrt{(1.682)^2 + (1.970)^2} = 2.59 \text{ inches}$
7	$Y'' = \sqrt{(0.853)^2 + (2.791)^2} = 2.92 \text{ inches}$
8	$Y'' = 2.99 \text{ inches}$
9	$Y'' = 2.78 \text{ inches}$
10	$Y'' = 2.43 \text{ inches}$
11	$Y'' = 2.25 \text{ inches}$
12	$Y'' = 2.31 \text{ inches}$
13	$Y'' = 2.59 \text{ inches}$
14	$Y'' = 2.92 \text{ inches}$

Tooth-space Number	j, inches
1	$j = \frac{5.236 - (2.99 + 2.25)}{2} = 0.000 \text{ inch}$
2	$j = \frac{5.236 - (2.78 + 2.43)}{2} = 0.013 \text{ inch}$
3	$j = \frac{5.236 - (2.43 + 2.78)}{2} = 0.013 \text{ inch}$
4	$j = \frac{5.236 - (2.25 + 2.99)}{2} = 0.000 \text{ inch}$
5	$j = \frac{5.236 - (2.31 + 2.92)}{2} = 0.003 \text{ inch}$

$$6 \quad j = \frac{5.236 - (2.59 + 2.59)}{2} = 0.028 \text{ inch} \quad (19)$$

$$7 \quad j = \frac{5.236 - (2.92 + 2.31)}{2} = 0.003 \text{ inch} \quad (19)$$

$$8 \quad j = 0.000 \text{ inch}$$

$$9 \quad j = 0.013 \text{ inch}$$

$$10 \quad j = 0.013 \text{ inch}$$

$$11 \quad j = 0.000 \text{ inch}$$

$$12 \quad j = 0.003 \text{ inch}$$

$$13 \quad j = 0.028 \text{ inch}$$

$$14 \quad j = 0.003 \text{ inch}$$

Tooth-space Number	Y', inches
1	$Y' = 2.99 + 0.000 = 2.990 \text{ inches}$
2	$Y' = 2.78 + 0.013 = 2.793 \text{ inches}$
3	$Y' = 2.43 + 0.013 = 2.443 \text{ inches}$
4	$Y' = 2.25 + 0.000 = 2.250 \text{ inches}$
5	$Y' = 2.31 + 0.003 = 2.313 \text{ inches}$
6	$Y' = 2.59 + 0.028 = 2.618 \text{ inches}$
7	$Y' = 2.92 + 0.003 = 2.923 \text{ inches}$
8	$Y' = 2.990 \text{ inches}$
9	$Y' = 2.793 \text{ inches}$
10	$Y' = 2.443 \text{ inches}$
11	$Y' = 2.250 \text{ inches}$
12	$Y' = 2.313 \text{ inches}$
13	$Y' = 2.618 \text{ inches}$
14	$Y' = 2.923 \text{ inches}$

Tooth-space Number	Tan y',	y', degrees
3	$\tan y' = \frac{1.952}{1.442} = 1.354$	$y' = 53.550 \text{ degrees}$
4	$\tan y' = \frac{2.232}{0.295} = 7.560$	$y' = 82.466 \text{ degrees}$
5	$\tan y' = \frac{2.132}{0.879} = 2.425$	$y' = 67.591 \text{ degrees}$
6	$\tan y' = \frac{1.682}{1.970} = 0.854$	$y' = 40.500 \text{ degrees}$

Tooth-space Number	w', degrees
3	$w' = 53.550 + 22.512 = 76.062 \text{ degrees}$
4	$w' = 82.466 + 4.502 = 86.968 \text{ degrees}$
5	$w' = 67.591 + 13.508 = 81.099 \text{ degrees}$
6	$w' = 40.500 + 31.518 = 72.018 \text{ degrees}$
10	$w' = 76.062 \text{ degrees}$
11	$w' = 86.968 \text{ degrees}$
12	$w' = 81.099 \text{ degrees}$
13	$w' = 72.018 \text{ degrees}$

Tooth-space Number	H'', inches
1	$H'' = 1.854 + 1.146 \times 0.98730 = 2.984 \text{ inches}$
2	$H'' = 1.854 + 1.146 \times 0.69835 = 2.654 \text{ inches}$
3	$H'' = 2.43 \times 0.97056 = 2.356 \text{ inches}$
4	$H'' = 2.25 \times 0.99860 = 2.248 \text{ inches}$
5	$H'' = 2.31 \times 0.98796 = 2.281 \text{ inches}$
6	$H'' = 2.59 \times 0.95115 = 2.460 \text{ inches}$
7	$H'' = 1.854 + 1.146 \times 0.88760 = 2.871 \text{ inches}$
8	$H'' = 2.984 \text{ inches}$
9	$H'' = 2.654 \text{ inches}$
10	$H'' = 2.356 \text{ inches}$
11	$H'' = 2.248 \text{ inches}$
12	$H'' = 2.281 \text{ inches}$
13	$H'' = 2.460 \text{ inches}$
14	$H'' = 2.871 \text{ inches}$

Tooth-space Number	H', inches
1	$H' = 2.984 \text{ inches}$
2	$H' = \frac{2.654 \times 2.793}{2.78} = 2.667 \text{ inches}$
3	$H' = \frac{2.356 \times 2.443}{2.43} = 2.370 \text{ inches}$
4	$H' = 2.248 \text{ inches}$
5	$H' = \frac{2.281 \times 2.313}{2.31} = 2.283 \text{ inches}$

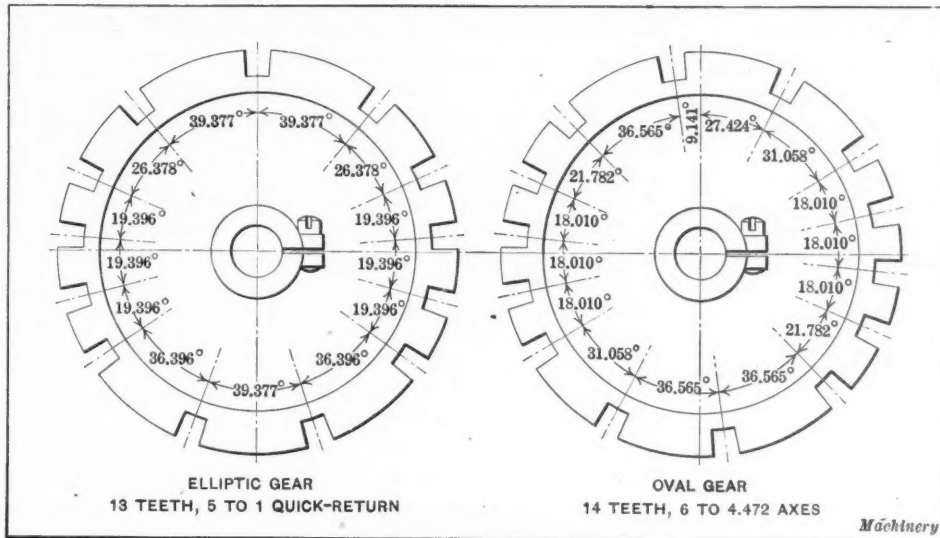


Fig. 9. Index Ratchet Wheels

$$6 \quad H' = \frac{2.460 \times 2.618}{2.59} = 2.486 \text{ inches} \quad (24)$$

$$7 \quad H' = \frac{2.871 \times 2.923}{2.92} = 2.874 \text{ inches} \quad (24)$$

$$8 \quad H' = 2.984 \text{ inches}$$

$$9 \quad H' = 2.667 \text{ inches}$$

$$10 \quad H' = 2.370 \text{ inches}$$

$$11 \quad H' = 2.248 \text{ inches}$$

$$12 \quad H' = 2.283 \text{ inches}$$

$$13 \quad H' = 2.486 \text{ inches}$$

$$14 \quad H' = 2.874 \text{ inches}$$

Tooth-space
Number

$$1 \quad D' = 1.146 \times 0.15889 = 0.182 \text{ inch} \quad (25)$$

$$2 \quad D' = 1.146 \times 0.71576 = 0.820 \text{ inch} \quad (25)$$

$$3 \quad D' = 2.430 \times 0.24087 = 0.586 \text{ inch} \quad (25a)$$

$$4 \quad D' = 2.250 \times 0.05292 = 0.119 \text{ inch} \quad (25a)$$

$$5 \quad D' = 2.310 \times 0.15471 = 0.357 \text{ inch} \quad (25a)$$

$$6 \quad D' = 2.590 \times 0.30874 = 0.800 \text{ inch} \quad (25a)$$

$$7 \quad D' = 1.146 \times 0.46057 = 0.528 \text{ inch} \quad (25)$$

$$8 \quad D' = 0.182 \text{ inch}$$

$$9 \quad D' = 0.820 \text{ inch}$$

$$10 \quad D' = 0.586 \text{ inch}$$

$$11 \quad D' = 0.119 \text{ inch}$$

$$12 \quad D' = 0.357 \text{ inch}$$

$$13 \quad D' = 0.800 \text{ inch}$$

$$14 \quad D' = 0.528 \text{ inch}$$

Machining the Gears

Of the numerous dimensions and calculations required for the correct design of the gears in the drafting-room, but three are of interest to the operator cutting the gears, after the proper cutter, or cutters, have been selected. These are the angle included between the tooth-space tangent and the major axis of the gear (or the angularity of the ratchet index), the horizontal and the vertical setting for the machining fixture. Any other information given to the machinist is likely to create confusion and lead to errors in his exacting task. A machining fixture secured to the table of the milling machine employed for cutting the teeth is the only special equipment required.

A simple and essentially practical fixture employed by the Bilgram Machine Works carries an arbor that may be set at any predetermined angle, upon which the blank to be cut is mounted on its bore. The angle at which the arbor is set is the angle included between the tooth-space tangent and the major axis, or the complement of such angle, and varies for the different tooth spaces. The distance between the parallel planes of the machining-fixture arbor and of the rotary cutter is adjusted for each individual tooth space so that the distance between the plane of the arbor and the parallel plane tangent to the pitch circumference of the rotary cutter in the cutting plane equals the vertical setting for the machining fixture previously determined. The coordinate setting of the fixture (or the horizontal setting for the machining fixture) is the distance between the plane of the rotary cutter and a

parallel plane passing through the arbor of the fixture. This is similarly set, for each individual tooth space, to conform to the calculated value. These three adjustments must be made for each tooth space, and it is this multiplicity of adjustments that makes the cutting of elliptical gears intricate.

The teeth should be cut in consecutive order, so that the angular adjustment of the fixture arbor, though varying in amount from tooth space to tooth space, is always in the same direction. In the multiple production of elliptical gears, this is taken advantage of by mounting on the fixture arbor a ratchet wheel with notches that conform to the angular adjustments for the various tooth spaces. The most convenient ratchet wheel

is circular and concentric with the fixture arbor so that the notches in its circumference are of varying pitch, their angular pitch conforming to the angle included between the center line of the rotary cutter and the major axis of the gear blank in successive positions. The 0—180 degree ratchet diameter should conform to the major axis of the gear. The ratchet angle for the normal for any particular notch is referred to in the notation and the examples as the "angularity of ratchet index." For any particular tooth space, this is the complement of the angle included between the tangent at such tooth space and the major axis. This arbitrary fixing of the ratchet angularity is dependent on commencing the cutting of the teeth at the small end of the gear; the first tooth space to be gashed is that on the major axis for elliptic gears, or that immediately to the left of the major axis for oval gears.

Fig. 9 illustrates the location of ratchet notches for the gears proportioned in the examples. The use of such ratchet indexes materially simplifies the question of the angular adjustment of the fixture and at the same time aids in securing uniformity in the product, the operator being relieved of much of the difficulty in making adjustments. Still further accuracy can be secured, when the gears are not of unusually wide face and can be securely bound together, by cutting several blanks at the same time. This is not always advisable, however. If the hubs of the gears are appreciably longer than the face of the gears, little time is saved; and should there be any variation in the metal of the blanks, there is increased danger of error through the work being forced out of alignment.

When the gears do not differ greatly in their major and minor axes—when their pitch outline does not vary much from a circle—the same cutter may be employed for all teeth; but when the ellipse is comparatively flat and there is considerable difference between the major and minor axes, a different cutter should be used for the major-radius segments from the one used for cutting the tooth spaces falling within the minor-radius segments. The cutter is selected, not for the number of teeth in the elliptical gear, but for the number of teeth of the same circular pitch that would be required for a circular gear having a diameter equal to twice the segment radius. For instance, the minor radius of the elliptic gear of Example 1 is 1.854 inch, the major radius is 3.764 inches, and the circular pitch is 1.2742 inch. The cutter for the spaces within the minor-radius segments should then be selected for a circular gear of the same pitch but with from nine to ten teeth ($2 \times 1.854 \times 3.1416/1.2742$); and the cutter for the spaces within the major-radius segments the same as for a circular gear with from eighteen to nineteen teeth ($2 \times 3.764 \times 3.1416/1.2742$).

* * *

Men who strive to build themselves up by tearing down the work of their fellows generally succeed in undermining their own foundations and falling into the common ruin. The secret of success is cooperative effort and giving to every one credit for that which is his due.

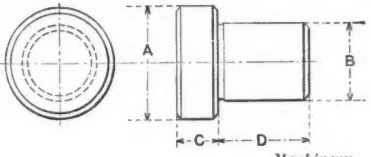
² Address: 265 Union St., Lynn, Mass.

adjustment or holding screw when it is preferable not to have a lug on the casting itself. For instance, to facilitate the production of the jig or fixture, one might want to shape or plane a surface, an operation that would be difficult and expensive if a screw-supporting lug was in the way as part of the casting. Also, at times, the hole in the lug may not be accessible for drilling and tapping. Poppets are also used to support drill bushings.

Milled push-pins, as shown in Table 3, are used in small jigs and on very delicate work. They provide a removable supporting point for the work, replacing the screws commonly used, and thus eliminating danger of distortion of the work or jig by the operator. Push-pins can also be more quickly removed than a screw, an advantage which may be borne in mind. They are milled as shown, not only to keep the binding screw from burring the pin, but also to keep the pin from falling out.

The knurled pins in Table 4 are simply hardened and ground pins used either to insure the proper placing of the work (after which the pin is removed), or to pin together two loose parts of a jig. In the latter case, the pin, as well as the bushings that it enters, is tapered. It is used, for instance, in a swinging side leaf or a cover that may not otherwise be

TABLE 5. HARDENED SEATS OR LOCATING PLUGS

							
A	B	C	D	A	B	C	D
1/2	0.251	1/8	1/2	1/2	0.5635	1/2	3/8
5/8	0.3135	1/8	1/2	1	0.626	1/2	3/4
3/4	0.376	1/8	3/8	1 1/2	0.6885	1/2	1
7/8	0.4385	1/8	3/8	1 1/2	0.751	1/2	1 1/8
1	0.501	1/8	1/2

supported. Tables 6 and 7 simply give information as to the proportions of spring posts and knobs. The functions are quite apparent.

The primary object of this article is to call the attention of designing engineers to the fact that many parts of jigs and fixtures may be standardized, numbered, made by apprentices instead of skilled toolmakers, and kept in stock. It will also do away with the drawing of these parts over and over again by tool designers.

TABLE 6. SPRING POSTS

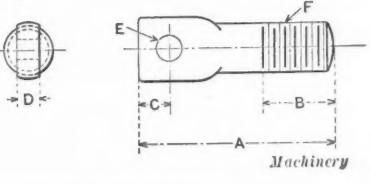
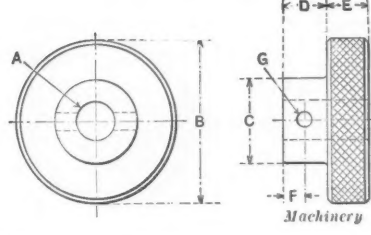
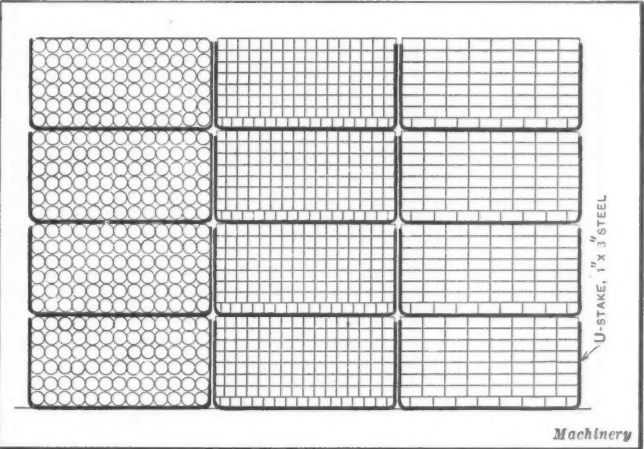
					
A	B	C	D	E	F Diameter and Number of Threads per Inch
1/2 to 1 1/2	1/8	3/32	1/8	1/8	No. 8-32
3/4 to 1 1/2	3/32	1/8	3/32	3/32	No. 10-32
1 to 1 1/2	1/4	1/8	1/4	1/4	No. 14-24
1 1/4 to 2 1/4	1/2	1/4	1/2	1/2	1/8-18
1 3/4 to 2 1/2	3/4	1/4	3/4	3/4	3/8-16
1 3/4 to 3	1	1/4	1	1	1/2-13
2 to 3 1/2	1 1/8	3/8	1 1/8	1 1/8	5/8-11
2 1/4 to 4 1/4	1 1/2	1/2	1 1/2	1 1/2	3/4-10

TABLE 7. KNOBS FOR JIGS AND FIXTURES

						
A	B	C	D	E	F	G
1/8	7/8	1/8	1/4	1/4	1/8	3/32
1/4 to 5/8	1 1/4	1/8	3/8	3/8	3/16	1/8
3/8 to 7/8	1 1/2	1/8	7/8	7/8	7/16	3/8
1/2 to 1 1/8	1 3/4	1/4	1	1	1/2	1/2
5/8 to 1 1/2	2 1/4	1 1/8	1 1/8	1 1/8	3/4	1 1/8

U-STAKES FOR PILING BAR STOCK

Racks for bars, strips, rods, pipe and other long metal stock are costly to construct and inconvenient to use. They are also inelastic and difficult to move when changes in the store-room are necessary. Racks may be avoided in many places by using piling stakes made of 1- by 3-inch steel bars bent to U shape, the U having a flat bottom and square corners, instead of a rounded contour. The stock is piled in these stakes, one being placed near each end of the pile. The width of the U-stake or frame may be from 30 to 36 inches and the height about 18 inches. When the pile has reached the top of the frames, another pair of frames is laid on the pile and the piling continued to any height required. Tiers may be ranged side by side, as indicated in the accompanying illustration, which shows piles of rounds, squares and flat stock, each held securely and neatly by the U-frames. When the stock is re-



Illustrating Use of U-stakes for piling Bar Stock

moved, there is no unsightly rack left to encumber the spot; the U-frames may be stored until required again, and new stock may be piled elsewhere if more convenient.

* * *

The number of establishments making watches, watch parts, and watch movements in this country decreased from thirty-seven in 1869 to fifteen in 1914. The number of employees increased from 1800 to 12,390; the wages, from \$1,304,000 to \$7,524,000, and the value of the products from \$2,819,000 to \$14,275,000. In the same period the number of watch-case factories fell from forty-nine to thirty-one, while the value of the products increased from \$2,333,300 to \$7,821,000. In 1909, however, twenty-nine establishments produced cases to the value of \$10,514,850. The imports of watches and watch parts have grown from \$2,293,670, in 1911, to \$3,362,720, in 1916, while the exports fell from \$1,560,870 to \$1,524,430. In 1915, only \$914,770 worth of American watches and watch parts were sold abroad.

MACHINERY

DESIGN — CONSTRUCTION — OPERATION

PUBLISHED MONTHLY

140-148 LAFAYETTE STREET, NEW YORK

England
51-52 Chancery Lane
London



Cable Addresses
Machinery, New York
Machtool, London

THE
INDUSTRIAL PRESS
PUBLISHERS

ALEXANDER LUCHARS
PRESIDENT

MATTHEW J. O'NEILL
GENERAL MANAGER

ROBERT B. LUCHARS
SECRETARY

FRED E. ROGERS
EDITOR

ASSOCIATE EDITORS
ERIK OBERG
FRANKLIN D. JONES
CHESTER L. LUCAS
EDWARD K. HAMMOND
VICTOR BROOK

AUGUST, 1917

NET CIRCULATION FOR JULY, 1917, 23,132 COPIES

Copyright, 1917, by THE INDUSTRIAL PRESS. Entered at the post-office in New York City as second-class mail matter. Yearly subscription, \$2; Canada, \$3; foreign countries, \$5. The receipt of a subscription is acknowledged by sending the current number. Checks and money orders should be made payable to THE INDUSTRIAL PRESS. Money enclosed in letters is at the risk of the sender. Changes of address must reach us by the 15th to take effect on the following month; give old address as well as new. Single copies can be obtained through any newsdealer.

We solicit contributions from practical men on subjects pertaining to machine shop practice and machine design. All contributed matter published exclusively in MACHINERY is paid for at our regular space rates unless other terms are agreed on.

FARM TRACTORS NOW AND AFTER THE WAR

The world is facing a shortage of food, now and after the war, and it is imperative for the farms to produce the maximum of food products at a minimum of cost. Farmers generally depend on animals for tractive power, but it is evident that in this mechanical age animal power must give way to tractors, which are propelled by engines fed by fuels cheaper than hay and grain—the food of the horse. The tractor is economical of farm labor because of the concentration of power under the control of one man. A tractor capable of exerting the draft power of many horses can be readily handled by one man, with comparatively little mechanical knowledge. The high-powered tractor capable of hauling ten plows at a uniform speed of 2 1/3 miles an hour, and operated by two men, will in a day of ten hours plow as much land as could be turned over by twenty single plows drawn by horses.

The adaptable farm tractor is that which can be used for all agricultural purposes, and which may also be used with a fair degree of efficiency for hauling produce to market. This combination of qualities is difficult to secure in one machine, but it is essential for the small farmers in the East to secure in one machine all the draft qualities of the horse in order to minimize investment.

A difficulty in the development of tractors and other machines driven by internal combustion motors, is the high price of gasoline and the apparent limitation of the world's supply of petroleum. The prospect of cheap alcohol seems remote. There is, it is true, the possibility of making gasoline from oil-bearing shales, but at present the cost of gasoline so produced is greater than that made in the ordinary way.

The future development of transportation methods on land and sea and in the air, and the improvement of agricultural conditions, hinges on the internal combustion motor. The improvement of motors and the development of cheap liquid fuels are fascinating subjects for invention and investigation.

REPLACING OLD MACHINE TOOLS WITH NEW

Now is the time for owners of manufacturing plants to consider ways and means for increasing the productive capacity of their plants without adding more buildings, which the pres-

ent high cost of materials and labor will make an excessive burden in future. Never was it so necessary for owners and managers to give close attention to the interior arrangement of their plants, methods of routing work, and efficiency of machines. Many plants have machine shops in which there are machine tools that should have been scrapped years ago. It is not uncommon to find lathes thirty or forty years old that are still in use. These old-timers take up the same area of floor space as a modern machine tool with a productive capacity of fifty to one hundred per cent more. Obviously, the simplest way—and the cheapest in the end—to increase the productive capacity of an out-of-date machine shop is to discard the ancient tools and replace them with modern equipment. The labor cost will be decreased and the productive capacity of the plant, as a whole, materially increased.

There are few manufacturing plants in which the floor space is utilized nearly to its capacity. The use of efficient machine tools is a step in the right direction; efficient transportation means, and methods which prevent congestion on the floors and which keep the operators supplied with work is another. An important matter to be considered when purchasing new machine equipment is the floor space occupied. In some cases it will be found that the vertical type of machine tool is best suited to the product, and that the floor space required is less for a given production than it would be with machines of the horizontal type. If the horizontal type is required—lathes, for example—they should be no longer than necessary to accommodate the maximum length of piece to be produced. It is a mistake to purchase engine lathes with long beds when the maximum length of the pieces to be turned requires short bed lathes only.

* * *

IMPORTANCE OF STUDY OF SHOP MATHEMATICS

Mathematics may be said to be the foundation of all engineering. Without the aid of the processes of arithmetic, even the simplest mechanical work could hardly be done. In the design of machinery, and still more in the design of great engineering structures, calculations of a more or less advanced nature become absolutely necessary. Any mechanic with a limited education who contemplates the study of mathematics should make certain that he has fully mastered arithmetic. Just as mathematics is the basic science underlying engineering, so arithmetic is the basis of all mathematics. Without a thorough understanding of every process in arithmetic, other mathematical studies become difficult, if not impossible.

Many shop men refrain from using handbooks and other mechanical books containing formulas because they believe that an understanding of algebra is necessary in order to make use of such formulas as are given in handbooks. This idea is erroneous. With few exceptions, the formulas given in handbooks intended for machine shops can be used by anyone who thoroughly understands arithmetic. All that is necessary is to spend an hour or two reading an article explaining the purpose and use of formulas. In mathematics, a number of abbreviations, signs and symbols are also used; and it is of considerable value to the man who reads mechanical literature and occasionally uses formulas to memorize the commonly used signs and abbreviations. This will facilitate his progress and make it easier for him to grasp the meaning of a formula which otherwise would be obscure.

Closely allied to the use of formulas is the use of diagrams. A formula records a mathematical statement by means of symbols or letters, while a diagram records a similar statement graphically by means of lines. Many mechanics regard a diagram as something difficult to understand, but this is not the case, as anyone can easily find by studying a few of the diagrams presented in the mechanical journals.

The student who wishes to go further into the study of elementary mathematics should begin with a simple course in the solution of triangles and elementary geometry. If he wishes to proceed still further, he should take up logarithms and the solution of equations, and in connection with the latter subject he would acquire the rudiments of algebra.

THE LAW OF WARRANTIES

BY CHESLA C. SHERLOCK¹

There are two kinds of warranties under the legal conception of the term, *viz.*, express and implied. An express warranty is a special warranty that expressly binds the maker thereof as to the fitness of a particular thing; while an implied warranty is a guaranty implied from the nature of the thing, the relation of the parties, or the agreement between them. Warranties cover a wide field and take in almost every phase of contractual relations. As applied to machinery, some special rules are in force that do not apply in other cases. Especially valuable and interesting is the rule of law as to which warranty governs a sale; that is, does the fact that a manufacturer expressly warrants a machine exclude or include implied warranties, or must the purchaser stand on the express warranty alone?

The Kentucky courts state the general rule to be that where there is an express warranty, there is no implied warranty. In the case under consideration, the contract provided that the machinery was sold subject "to the following express warranty and agreement, and none other." In Michigan, the rule is held to be that if there is "an express warranty as to the working qualities of machinery, there is no implication that the machinery is fit for the purposes for which it was purchased." In Indiana, the court said that although it is true that when a machine or other article is sold for a particular purpose there is an implied warranty that it is reasonably fit for the purpose for which it was made and sold, this rule does not apply where there is an express written warranty, since, in such cases, implied warranties are excluded. In Georgia, it is said that only in the absence of express warranties can resort be had to an implied warranty that a machine is reasonably fit for the use intended. In Illinois, the rule is: "Where a manufacturer furnishes a heating apparatus designed for heating a specific building, he impliedly warrants the sufficiency of the apparatus for the purpose intended. This implied warranty, however, cannot be availed of if the apparatus is sold upon an express warranty as to the temperature to which it will heat the rooms which it is designed to heat." In a Wisconsin case, it was stated that an express warranty of workmanship and material of cream separators excludes an implied warranty of fitness. In a Maine case, the court said: "The existence of an implied warranty that an automatic governor should be suitable for the purposes of the buyer's plant is negated by the fact that the contract of purchase contained an express warranty as to quality as well as to speed, and the governors were such as the seller in the ordinary course of his business manufactured for the market, the general rule being that where an express warranty is made upon a sale, no other will be implied." The Missouri courts, however, have taken the other side of the question. They have held that there might be express warranties that do not exclude implied warranties, as there are any number of implied warranties that were never contemplated at the time the express warranties were made. This exception was not held, however, to apply to an implied warranty which in itself formed an integral element of the express warranty, into which it merged and by which its effect was circumscribed. The holding of the Missouri courts is on the theory that the express warranty is as to something wholly independent of the implied warranty. This distinction is as important as the distinction between express and implied warranties themselves.

It is a general rule, then, that an express warranty as to a particular phase of a thing will exclude all implied warranties as to the same thing. This rule is supported by the great weight of judicial authority and is practically universal. There are, however, some exceptions to the rule that are equally well supported by the weight of authority. In order for the general rule to apply, the character of the article warranted, as well as the express warranty thereto, must include all implied warranties on the same subject. The express warranty must also be of such a nature as to negative any contention that the manufacturer intended to assume any other obligation than the one assumed in his express warranty. If

such a tendency does clearly exist, the courts are likely to declare that the implied warranties and the express warranties are separate in the particular case.

The law of warranties is so comprehensive a subject that it is possible to state here only the rules in force in cases involving machinery. The rules of law are the guide posts that point the way, and when a man is once familiar with these rules, he may proceed without stumbling through a maze of hazy legal decisions and counter decisions. The things to remember are that an express warranty excludes all implied warranties to the same subject, and that implied warranties will be considered either in the absence of express warranties or where it can be inferred from the agreement of the parties or the nature of the thing warranted that implied warranties were not intended to be included in the express warranty.

* * *

RELATION OF RATE OF COOLING TO PHYSICAL PROPERTIES OF FORGINGS¹

Two locomotive driving axles were used in some experiments recently conducted to study the rate of cooling in different medias and to try to connect the rate of cooling with the physical properties obtainable in quenched and tempered forgings. One of these axles was 11 inches in diameter and weighed 1830 pounds; the other was 12 inches in diameter, had a 3-inch hole bored longitudinally through it, and weighed 2000 pounds. In each case, the axles were heated uniformly as for quenching in the usual course of manufacture. The cutting compound used for quenching was composed of mineralized lard oil and soft soap mixed with equal parts of water. It was later diluted to one part of compound and two parts of water, and still later to three parts of water.

The tests show that in air the solid axles cool at a rate of 10 degrees F. per minute; in heavy oil, 26 degrees Baumé, at the rate of 25 degrees per minute; in the oil solution, at the rate of 35 degrees; in light oil, 29 degrees Baumé, at the rate of 45 degrees; and in water, at the rate of 80 degrees. The bored axle cooled in both the heavy oil and the cutting compound at the rate of 40 degree per minute. It was found that the dilution of the compound had little effect on its quenching properties.

In the case of the bored axle, it was found that when the 25 per cent solution of cutting compound was used, the axle cooled from 1450 to 700 degrees F. in 16.1 minutes. Its elastic limit was 40,500 pounds per square inch; its tensile strength was 78,000 pounds; its elongation in 2 inches, 29 per cent; and its reduction in area, 55 per cent. But when placed in the 33 per cent solution, the bored axle cooled in 13.6 minutes; its elastic limit was 43,000 pounds; its tensile strength, 81,500 pounds; its elongation in 2 inches, 30 per cent; and its reduction in area, 53.5 per cent. It was thought, however, that this more rapid cooling was due to some local condition that affected the convection of the bath.

When a jet of compressed air was introduced into the bath to give it a vigorous circulation, the rate of temperature fall was increased 80 per cent. Carbon steel that in the still bath had an elastic limit of 49,500 pounds per square inch, a tensile strength of 95,000 pounds, an elongation in 2 inches of 20.5 per cent, and a reduction in area of 43.5 per cent, when quenched in the agitated bath had an elastic limit of 68,800 pounds, a tensile strength of 105,300 pounds, an elongation in 2 inches of 21 per cent, and a reduction in area of 42 per cent. Chrome-vanadium steel axles quenched in a still bath had an elastic limit of 80,500 pounds per square inch, a tensile strength of 123,500 pounds, an elongation of 20.5 per cent, and a reduction of area of 57.5 per cent. When quenched in an agitated bath, this steel had an elastic limit of 90,000 pounds, a tensile strength of 124,000 pounds, an elongation of 16.5 per cent, and a reduction of area of 61.5 per cent.

* * *

Last year, 4676 automobiles were imported into Argentina, against 1847 in 1915. Most of these were small cars designed particularly for country use, as such cars are becoming popular among the farmers.

¹Abstract of a paper by Lawrence H. Fry, read before the Iron and Steel Institute of Great Britain, May, 1917.

¹Address: Box 253, Des Moines, Iowa.

SNAPSHOTS ON THE ROAD

THE RIGHT SIDE OF A PIECE OF STEEL—ASSEMBLING A CLOCK MOVEMENT IN TWO MINUTES—BROACHING CAST IRON—DUPLICATE FORM TURNING—WHAT'S THE MATTER WITH THE MUNITIONS MAKERS?—HOW A DOUBLE-ANGLE MILLING JOB WAS HANDLED—LAPPING GAGES FOR PROFIT—USING UP HIGH-SPEED STEEL DRILLS

BY THE FIELD EDITORS



"—the bottom side hardened to perfection while the face was as soft as cheese"

THERE are still a few shops in the country that make use of what is known as "composite steel" for blanking die work. Composite steel is formed by rolling together a piece of iron and a piece of tool steel. The result is a plate, one side of which is steel and the other iron. It has been claimed that a die made from this steel could be machined with less trouble than a solid steel die, and with practically no danger from cracking in hardening. While looking around through one of these shops where composite steel had

been a great favorite, we heard the following incident, which has a mechanical moral:

"It was in the days when I was toolmaking," said the manager of the jewelry making plant—"and I was considered a pretty good die-sinker, too—that one day we had a little emblem die to make from which but a few strikings were required, so I picked up a scrap of composite steel and commenced to sink the design. After working on this for five or six hours, I tumbled to the fact that it worked too soft, and the horrible suspicion came to me that I had the piece of composite steel wrong side up and was cutting the design in the iron face of the plate instead of the steel. The longer I worked at it, the surer I was that I was wrong, and as soon as I tried to harden the die I was positive, for the bottom side hardened to perfection while the face was as soft as cheese.

"Someone has made the remark that during the few seconds' interval between the time when think you have made a mistake and when you find out whether you have or not, you are getting real experience. Well, I went through those seconds and got the experience, but the next thing was how to get out of the dilemma. It was a rush job and we had no time nor facility for pack-hardening, so I casehardened with cyanide, soaking in the cyanide to get all the depth of case possible. Even then I doubt if the die would have passed, even for the small number of parts required, if I hadn't gotten on the right side of Old Tom, the drop man, and told him that I suspected that die was made of a poor piece of steel and to nurse it along as carefully as possible. Old Tom got out the order, but he did some cussing and declared at the end that that sure was some bum steel in that die."

Assembling a Clock Movement

In going about the field, many examples of manual dexterity are seen, especially in factories where girls are employed. Recently, while in a Connecticut clock shop, the superintendent called attention to the assembling of a movement for a cheap alarm clock. The girls on the job had large compartment trays, each space of which contained a quantity of wheels or shafts of one kind. The assembler dropped one of the frame plates of the movement onto a simple little fixture before her and with her right hand rapidly reached for the various wheels and shafts, located them in the frame,

and held them in place with her left hand.

How that right arm did fly! After she had all the wheels in their correct places in the frame plate, still loosely held in her left hand, she fitted on the top plate. With a quick little shake, at the same time rapidly adjusting the various parts with her left hand, she had the shafts and other parts in the proper

pivot holes in the two plates. The top plate was held in place by twirling two little nuts on diagonally opposite parts and the job was done—total elapsed time, less than two minutes!



"With a quick little shake . . . she had the shafts and other parts in the proper pivot holes"

Broaching Cast Iron

"We worried a lot over this machining problem," said the chief engineer of the plant that we were visiting, "and you will be interested to know how we finally solved the problem. Now here's what we had to do," said he, as he reached for a piece of paper and rapidly sketched away. "You see, there's an irregular cored slot that runs out of this cast-iron plate, which, by the way, is one inch thick. Of course, you will see we couldn't mill these quickly without a profiler, and our production wasn't great enough to install such a machine. We got through the job very nicely, however, by broaching."

"But we have always considered the broaching of cast iron a rather difficult job on account of the tendency to break out at the end of the broaching cut."

"You're dead right there, and that made the job all the more interesting. See, here's how we overcame that breaking-out tendency. We used three broaches for the job; the first left the outline of the slot in a succession of notches, just as I'm drawing it. We followed this broach by a second one that took 'bites' out of the center of each of the notches. Then we finished up with a plain broach that took the ridges from the slot and left it as finely finished as you could desire and without the sign of a break at the end of the cut."

"That's sure a new wrinkle in broaching," said we, "and a mighty good one to remember."

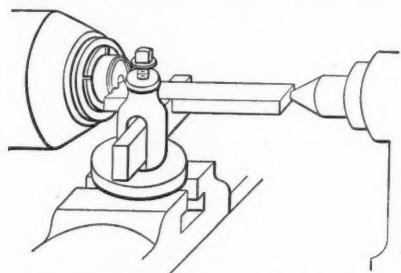
Duplicate Form Turning

It is surprising how often you see a new kink in some little shop where you wouldn't expect to find anything more modern than a grindstone. You may have to unearth it from beneath a pile of obsolete practice, but when you get it out it looks pretty good. Such was the case in a little job button manufacturing concern in good old New England. It seems that this company often has a set of fifteen or twenty sample buttons to turn, or molds for making buttons, or possibly punches for press work. It is necessary to face the molds or punches with the concentrically turned form and the exact form of the rings does not matter as long as they are all alike.



"We used three broaches for the job; the first left the outline of the slot in a succession of notches"

The boss lathe hand is an ingenious Yankee, and he has a "universal" form-turning tool that you can understand better from the sketch than from a page full of words. This form tool is made from a rectangular piece of steel about three-eighths by one inch and the shank is fitted in a slot in a block held in the toolpost, and is operated from the tail-center. The operation is simplicity itself. The lathe hand merely adjusts the tool by means of the cross-slide and feeds it in with the tailstock. The slot in the block of the cross-slide insures each punch, each button mold part or punch being turned exactly



"The boss lathe hand . . . has a 'universal' form-turning tool"

the same. A great number of variations are possible by merely moving the cross-slide and hence the tool, and as long as the cross-slide is moved the same amount for each operation, the pieces are exact duplicates.

It is a simple little kink and there ought

What's the Matter with the Munitions Makers?

We recently ran into a fine example of "frenzied buying" as done by one of the mushroom munition plants that have been so much in the limelight of late. It was told to us by an efficiency expert who had been called in to straighten out things after they had run so wild that no one knew where they were "at." One of the grinding-room foremen wanted a diamond for truing grinding wheels, and put in his requisition. He stated the approximate size that was required, and one of the buyers of the purchasing department promptly got busy and bought a pure, flawless, blue-white diamond, for which he paid the meager sum of \$900. The interesting part of it is that they did not send the diamond back, but actually put it into service truing grinding wheels.

Another glaring example of inefficiency was in an order of dies that was placed soon after the plant was started. An order for twenty-four duplicate dies for punching one particular part was given to a diemaking concern. The order was delivered promptly by putting every man in the shop on the job. After several months, it occurred to the diemaking concern that there ought to be another order coming for dies if such quantities had been needed before, so the manager went around to interview the purchasing department of the munitions plant. Being somewhat friendly with one of the purchasing agents, he naturally put his proposition to his friend, who simply smiled and said, "Come with me for a minute." Out through the shop they walked and into one of the storehouses, and there, stored in an orderly fashion, were twenty-three sets of the dies. These dies were all slushed with grease just as they had been received and had never seen service.

"Well," said the die manufacturer, "what's the answer?"

"Simplicity itself," was the reply. "The engineering department ordered us to secure twenty-four sets of dies for this part before they were sure that the part was exactly what they wanted. After a few thousand impressions had been made from the first set, they discovered that they were on the wrong track, and consequently these twenty-three sets of dies are scrapped."

How a Double-angle Milling Job was Handled

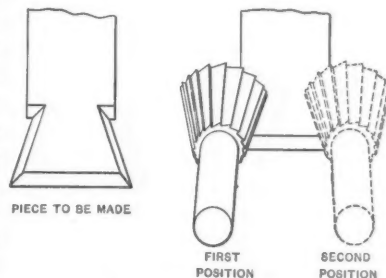
"Say," said the master mechanic, "we've just finished solving a pretty little milling job for producing a piece like this one I'm drawing, and I'll be interested to hear how you would have done it." The piece referred to was made of carbon steel and its end was dovetailed as shown. The complicated part of it was that the edges were not cut straight

across, but on an angle of about 5 degrees, similar to a milling cutter tooth.

"And before you decide just how you would have handled this," said the superintendent, "remember that it's a manufacturing job on which we must have thousands of parts, and we can't stand for a special machine, because on munition work the styles are apt to change at ten minutes' notice."

We racked our memory for a similar job without success, and, finding none, had to appeal to the superintendent for the explanation.

"Well, the solution was so simple it was funny we didn't strike it long ago. We simply had a special end-mill made to agree with the dovetail taper, and holding the pieces one at a time in a special fixture on the hand milling machine, ran the work straight up onto the cutter, but not across it; the resulting surface was angular and slightly concave. Next we dropped the work, ran it around the cutter to the opposite edge and milled it in the same way, and we got as pretty a result as you could want."



"the solution was so simple it was funny we didn't strike it long ago"

"Of course," concluded the superintendent, "you'll say we didn't get a perfectly true angle by using the surface left by a cylindrical end-mill, and you're right, but the resulting slightly concave surface was highly satisfactory and made an even better fit in the slot than it would have if it had been straight."

Lapping Gages for Profit

"Before you go," said the tool-room foreman, "sit down here and let me tell you about a big job of gage lapping that we had in the shop some time ago and how we handled it. You see, we only had one good man who could lap work and get away with it, and it was soon evident that we wouldn't be able to get the job out on time if we depended only on his ten-hour-a-day services, so we asked him about taking some of the work home and doing it evenings; we thought it would be pleasanter than staying at the factory, as none of the other men were working overtime."

"Schwarz was a big, good-natured German of a philosophical turn of mind. Every morning he brought in a good number of lapped gages and soon the contract was over. His overtime work did not seem to tire him, so one day, when the work was nearly done, I asked him how it was he could stand so much extra work without tiring, and he replied:

"'Oh, dot vas easy. I yust pull up mein chair side mit de lapping block, light mein pipe, and make one hand go, so and so, while I read mein paper mit comfort, and pretty soon I look at the gage—maybe he be all right, maybe not; that makes no never minds, I rub him some more and bimeby he sure be done.'"

"And so it was. Schwarz's gage lapping was no tax on his strength, because he reduced his right hand to an automaton that worked while he read—which wasn't so bad."

Using up High-speed Steel Drills

High-speed steel turning tools cost money these days, so anything new in the turning tool line attracts our attention. Not long ago we were walking by the tool stock-room of a shop in Syracuse, where we saw an unusual lathe tool. It seems that the company uses a lot of two-inch high-speed steel drills, and when they are worn down too short for the work, they are forged down and the twist is taken out, turning them into lathe tools. The men say they are the finest kind of turning tools, and they make a saving in the steel bill besides.



"I yust pull up mein chair side mit de lapping block, light mein pipe, and make one hand go so and so, while I read mein paper mit comfort"

GRIDLEY TURRET LATHE EQUIPMENT¹

CHUCKS, FORMING AND CUTTING-OFF TOOLS, DRILL-HOLDERS, KNURLING TOOL-HOLDERS, TURNERS, BACK-RESTS, ETC.

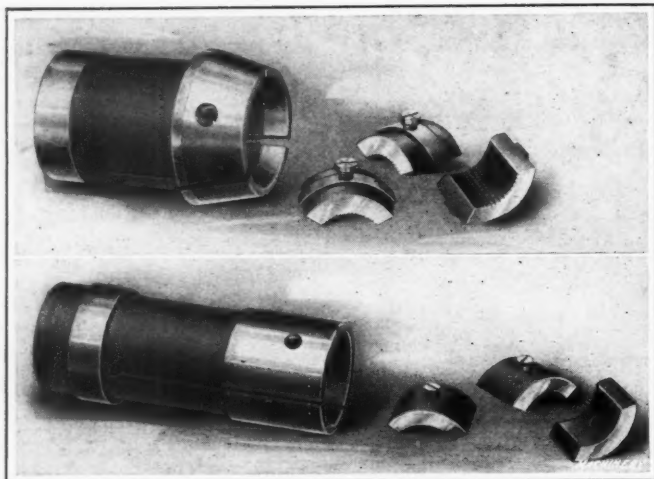
BY DOUGLAS T. HAMILTON²

Fig. 1. Master Spring Chuck and Feed Chuck with Gripping Jaws removed

THE tool equipment and attachments used on the Gridley single-spindle automatic turret lathes do not differ essentially from those used on the multiple-spindle type of machine. The tool-holders, however, are held on flat slides instead of on the corner of the turret, as in the multiple-spindle machines. The standard tool equipment consists of spring chucks, feed chucks, vertical and flat forming tools, blade-type cutting-off tools, drill-holders, facing tools, knurling tools, internal necking tools, turners, high-speed drilling attachments, automatic die attachments, releasing tap-holder attachment, and taper turning attachment. Other special tools, of course, can be designed when the character or shape of the work necessitates the performance of operations that cannot be handled with the standard equipment.

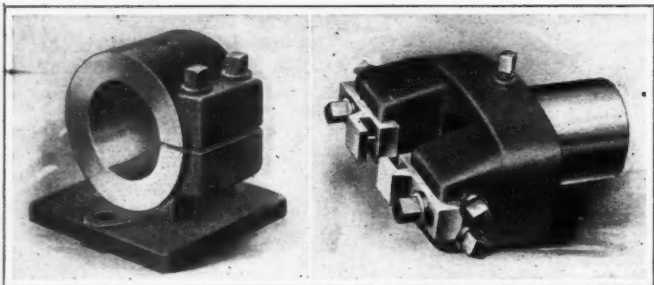


Fig. 2. Standard Type of Tool-holder used on Turret Slide of Gridley Automatic Turret Lathe

Fig. 3. Standard Type of Knurling Tool-holder for Use on Turret Slide of Gridley Automatic Turret Lathe

Spring Chuck and Feed Chuck

The spring chuck and the feed chuck used in the single-spindle turret lathe are exactly the same as those used on the multiple-spindle machines; in fact, the chucks used on the 1¾- and 2¼-inch sizes are interchangeable. On the single-spindle turret lathes, of course, the smallest capacity of the machine is such that the master spring chuck and feed chuck are used exclusively, and these are fitted with bushings to suit the size and shape of the work being handled. The illustration accompanying Table 1 shows the design of the spring chuck, and the principal dimensions are given for the 2¼-, 3¼- and 4¼-inch machines. It will be noticed in this connection that the taper on the front end of the chuck is only 14½ degrees on the 2¼-inch size, whereas it is 15 degrees on the 3¼- and 4¼-inch sizes. Another difference that should be no-

¹For other articles on Gridley automatic screw machine practice, see "Gridley Multiple-spindle Automatic Screw Machines" in the June and July, 1917, numbers of MACHINERY, and the articles referred to in connection with the first installment.

²Address: Fellows Gear Shaper Co., Springfield, Vt.

ticed is that the chucks used on the 3¼- and 4¼-inch sizes have four slots and four bushing sections, instead of three, as on the 2¼-inch size.

The illustration accompanying Table 2 shows the type of master feed chuck used and the table gives the principal dimensions. These chucks are also interchangeable with those on the same size of multiple-spindle machines, and the number of slots and bushing sections vary on the 3¼- and 4¼-inch sizes, as mentioned in connection with the spring chuck. On the 3¼- and 4¼-inch feed chucks, the diameter is not reduced at L, but the diameter A extends from the front back to the shoulder at J; otherwise the feed chucks used on the various sizes of machines are identical in shape. Fig. 1 shows a master spring chuck and a feed chuck with the bushings removed

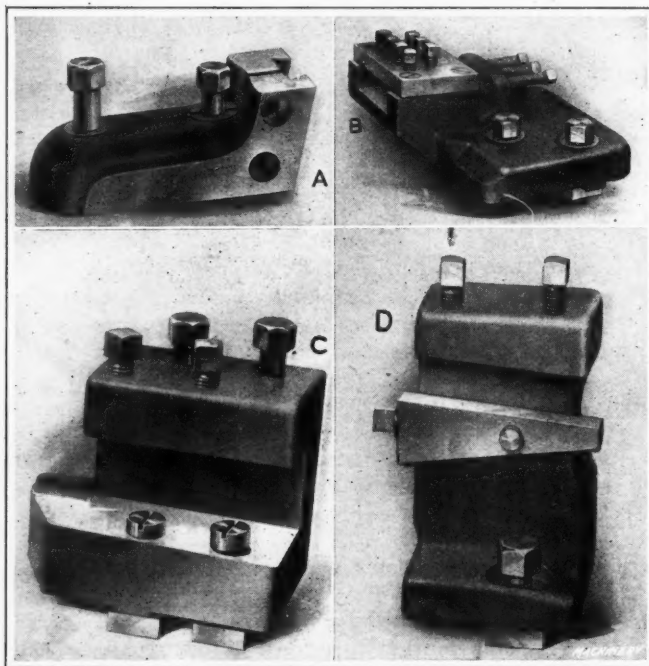


Fig. 4. Forming and Cutting-off Tool-holders used on Gridley Single-spindle Automatic Turret Lathe

and illustrates clearly the shape of the bushings and the method of holding them.

Forming and Cutting-off Tools

The forming and cutting-off tools used on the single-spindle turret lathe do not differ materially from those used on the multiple-spindle machine. When an irregular form is to be produced the vertical type of forming tool gives the best results. When several diameters are to be formed and only a small number of parts are to be turned out, individual forming tools consisting simply of blades for covering each diameter are satisfactory. It should be stated, however, that when a large number of parts are to be produced a tool covering the entire form, if possible, is better than a tool made up in separate parts, as it is easier to set up the tool again after

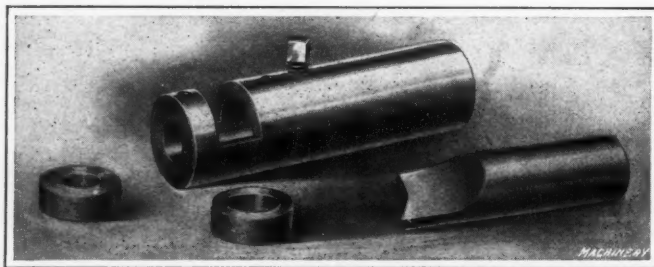
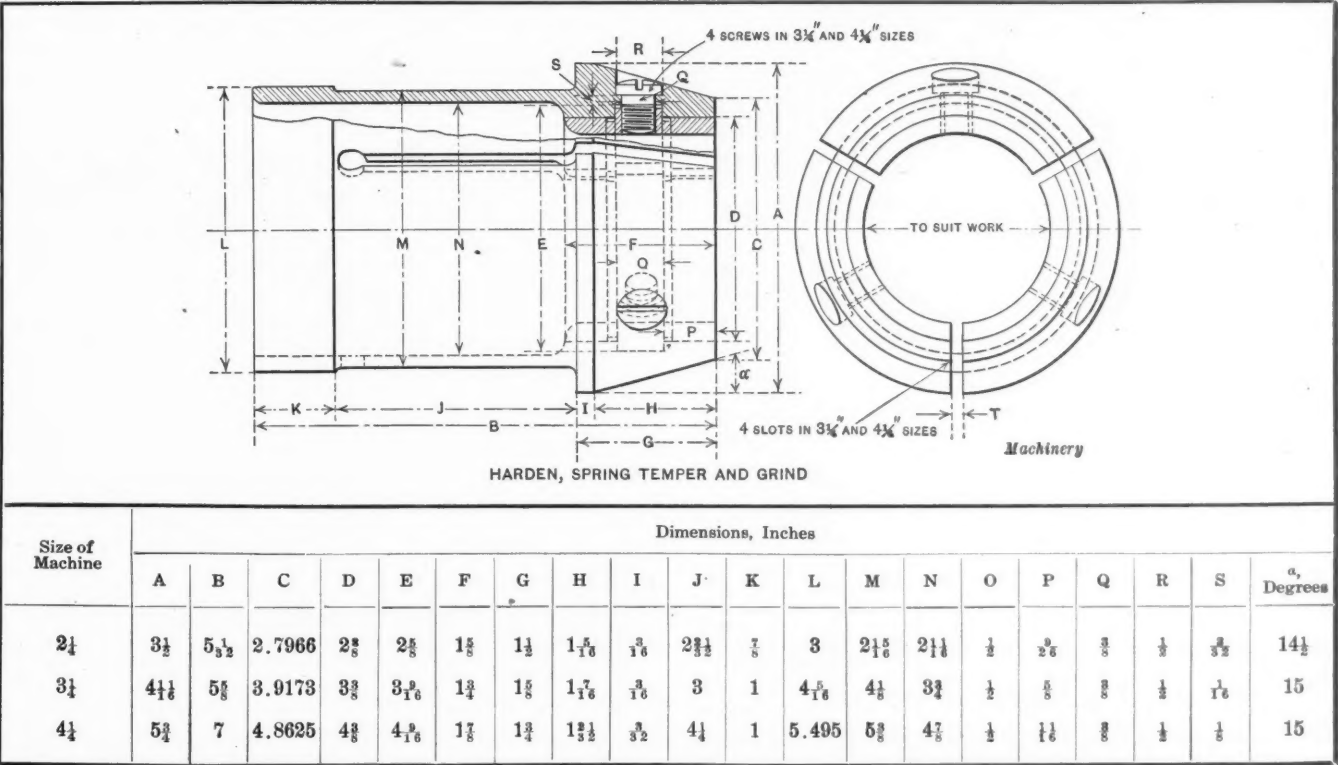


Fig. 5. Facing Tool and Holder used in Standard Tool-holder

TABLE 1. PRINCIPAL DIMENSIONS OF MASTER SPRING CHUCKS FOR GRIDLEY SINGLE-SPINDLE TURRET LATHES



it has been sharpened. The cutting-off tools are generally of the blade type, except when it is necessary to make them perform some part of the forming operation.

Forming and Cutting-off Tool-holders

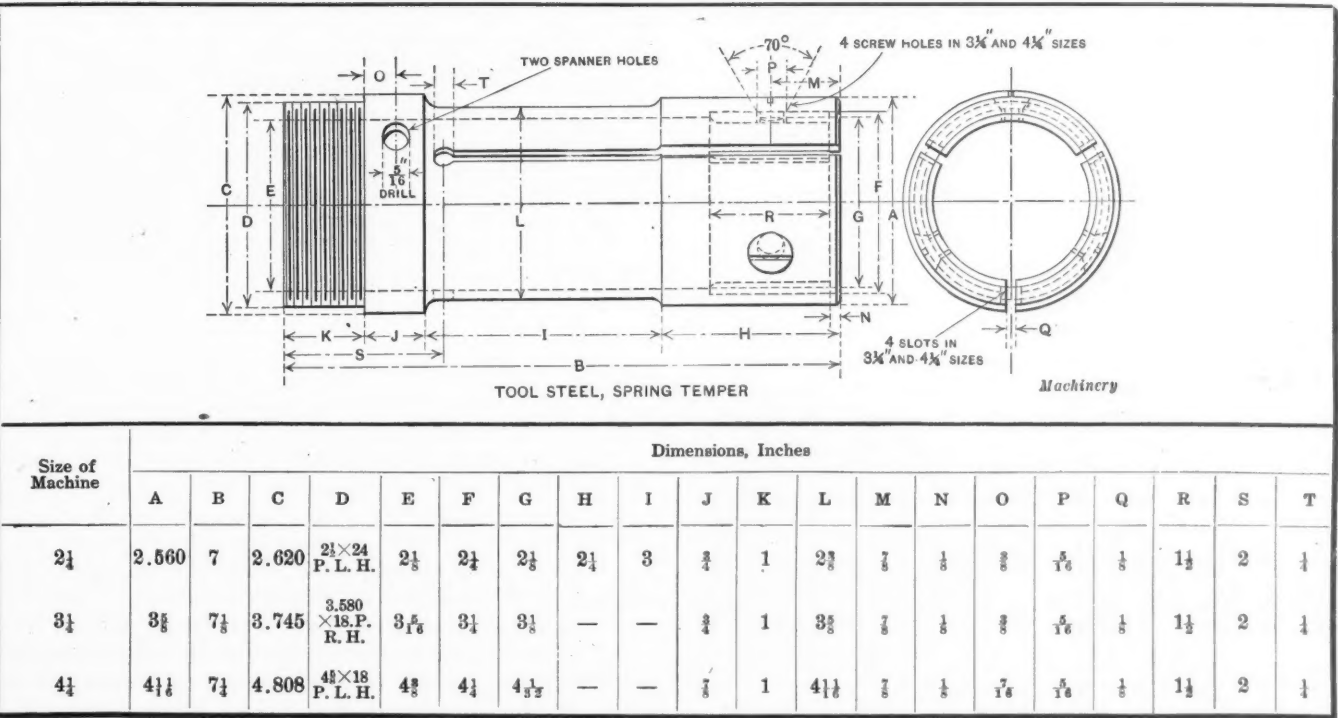
Fig. 4 shows types of forming and cutting-off tool-holders used on the single-spindle turret lathe. That shown at A is known as the vertical tool-holder and is the type generally used, because the cutting tool can be held much more rigidly than in the other designs. The tool also can be ground on its top face without changing the form on the work, and it has a longer life than the straight forming tool.

When the piece to be formed has several plain diameters, the flat forming tool-holder shown at B is sometimes found

convenient. This tool-holder, of course, is only used when there are a small number of pieces to be made and when the expense of making a vertical forming tool would not be warranted. It is also used when several narrow forming tools are required, spacing pieces being put in between the tools and the entire number clamped in the holder. Three adjusting screws are provided, as shown, so that three separate tools can be independently adjusted; they are then clamped by the other set of screws.

The plain forming tool-holder shown at C is sometimes used for forming back of the head of a screw or for similar work, so that the cutting-off tool is relieved of considerable work. It is also used for beveling the end of the bars before it is fed out, and thus assisting the turner in starting, especially in

TABLE 2. PRINCIPAL DIMENSIONS OF MASTER FEED CHUCKS FOR GRIDLEY SINGLE-SPINDLE TURRET LATHE



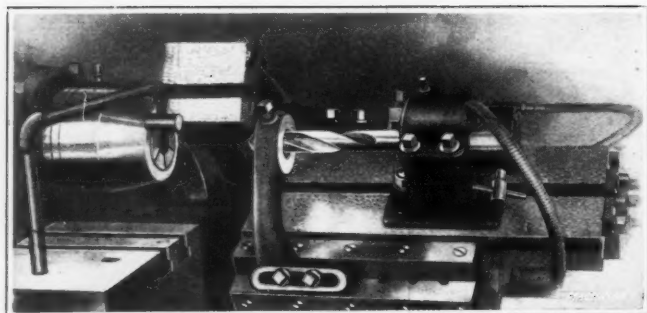


Fig. 6. Standard Type of Drill-holder and Drill-support in Operation

giving the back-rests a chance to support the work when the turning cut starts.

It shows the standard type of cutting-off tool-holder used on the single-spindle machine. This holder, as shown, is fitted with an adjustable taper wedge so that the cutting-off blade can be easily adjusted to correspond with the center of the work. Ordinary forged tools can be held in this holder or almost any type of blade inserted. When a large number of pieces are to be made it is advisable to use a blade-type of cutting-off tool and a holder. This simplifies the sharpening of the tool, as a blade-type tool has clearance all the way back

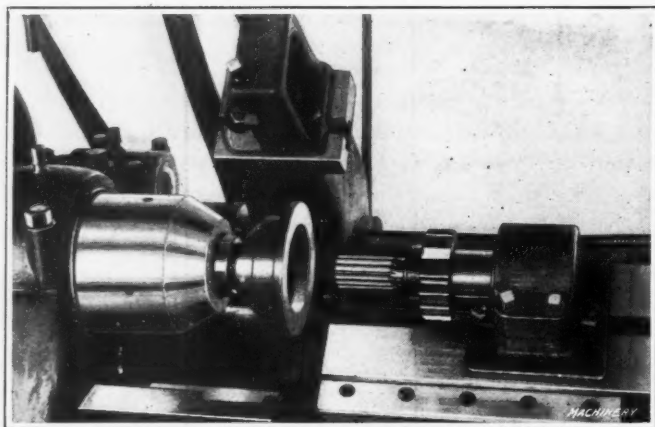


Fig. 7. Standard Tool-holder carrying Reamer

and to sharpen it is simply ground on the front end to the required cutting angle.

Tool-holders

The standard type of tool-holder used on the Gridley single-spindle turret lathe is shown in Fig. 2. This tool-holder is bolted directly to the turret slide and is bored out when in place on the machine so that the hole is in direct alignment with the spindle. It is held in place by means of two T-bolts, which, if desired, can be threaded; an adjusting screw laid in the T-slot in the slide can then be used for accurately ad-

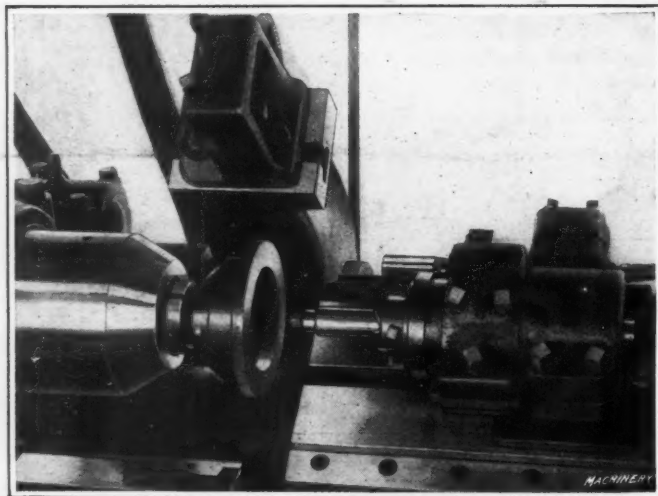


Fig. 8. Standard Holder carrying Reamer and Counterboring Tool

justing the tool-holder longitudinally along the slide. This screw, of course, is provided with a collet head, and a plate attached to the rear end of the slide acts as a stop for adjusting purposes. The various tool-holders are numbered to correspond with the number of the tool-slide to which they are fastened when finished, and should be used only on the tool-slide having that number. They can be used, of course,

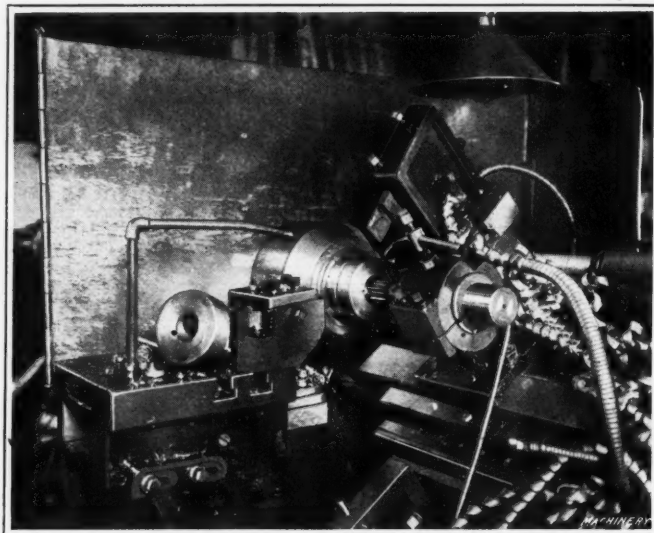


Fig. 9. Standard Type of Reamer Holder at Work

by the substitution of bushings and other independent holders for carrying facing tools, drills, pointing tools, etc. Fig. 5 shows a tool-holder arranged to hold a pointing tool. A separate bushing is provided for guiding the bar, and the pointing tool is held in another sleeve, the latter being retained in the holder.

Drill-holder and Support

In Fig. 6 is shown the standard tool-holder carrying a twist drill, which is held in a bushing fitting in the holder, so constructed that an oil-tube can be inserted for supplying a coolant to the drill. The drill should be of the oil-tube type, so that the oil can flow directly to the cutting point. In addition, the drill is supported close to the cutting point, by means of an arm which is fastened to the turret in such a position

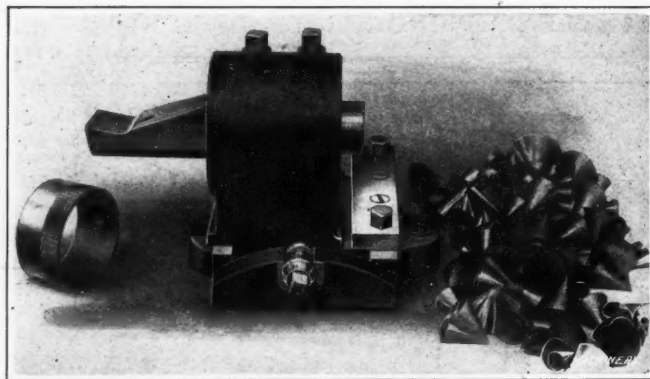


Fig. 10. Set-over Tool and Holder and Chip produced by it

that it is close to the end of the piece being drilled. The arm holds a bushing which fits the drill and accurately guides it in line with the work. This insures the tool starting concentrically and obviates the necessity of using a starting drill.

Fig. 9 shows a standard tool-holder carrying a reamer. The reamer is mounted so that it can float and is carried in a separate bushing in the tool-holder. In this illustration the screw for adjusting the main tool-holder longitudinally can be plainly seen, as well as the forged type of cutting-off tool, and the tool-holder for carrying separate forming tool blades. In Fig. 8 is illustrated another application of a reamer-holder, which is used in conjunction with a facing and counterboring tool. The reamer is of the shell type. The job shown is a

hub which is chucked by hand. Fig. 7 shows still another application of the standard holder. In this case it is used for carrying a boring tool, operating on a chucking job.

Knurling Tool-holder

The standard type of knurling tool-holder used on the Gridley automatic turret lathe is shown in Fig. 3. This has a

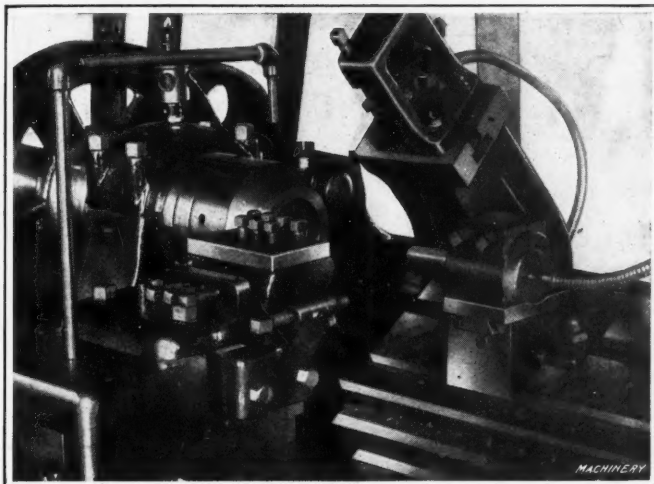


Fig. 11. Internal Necking or Recessing Tool

shank which can be held in the standard tool-holder and carries two adjustable slides that hold the spiral knurls. Two straight knurls can be used when it is necessary to produce a straight knurled effect on the work.

Set-over Tool and Holder

An interesting type of tool which takes the place of a drill for producing shallow holes (not more than one and one-half times its diameter) is shown in Figs. 10 and 12. This is known as a "set-over tool-holder," and it can be used with success on the Gridley turret because of the rigid construction of the latter. The cutting tool works the same as a forming tool, but instead of cutting on the outside surface of the bar, as the forming tool does, it cuts into the end of the bar, and as the holder which supports the tool has a set-over adjustment, the same cutting tool can be used for making holes of various diameters. It is not necessary to use a starting drill

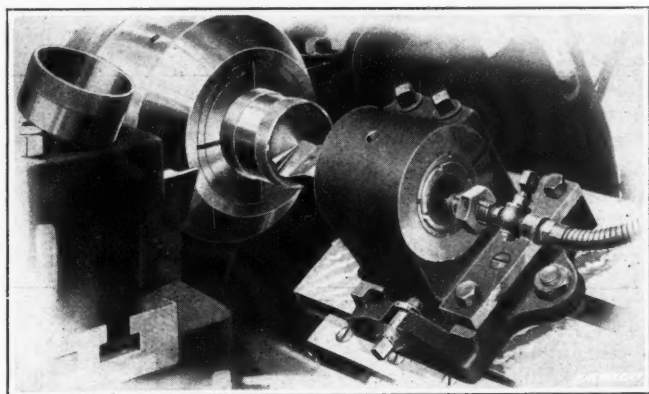


Fig. 12. Set-over Tool-holder in Operation on 3-inch Hole

with this tool and a counterbore can be dispensed with in most cases when the bottom of the hole in the piece is flat.

The cutting tool proper is made from high-speed steel with a hole through its center, so that the cutting edge is thoroughly flooded with cutting oil or compound. This tool is cheaper to make than a drill and can be used for making different sizes of holes, and also as a reamer. Fig. 12 shows the tool in operation, producing a hole that is three inches in diameter. Fig. 10 shows the kind of chips produced with this tool, and the set-over arrangement is also clearly shown. The holder carrying the cutting tool is mounted on a slide which is adjustable at right angles to the axis of the spindle by means of a collar-head screw, as illustrated. This adjust-

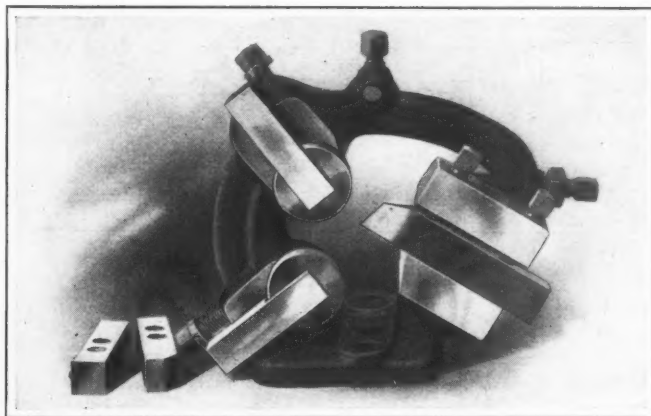


Fig. 13. Standard Type of Turner for Use on Gridley Automatic Turret Lathe

ment is made to secure the desired diameter of the hole in the work.

Internal Necking Tool

When it is necessary to make a recess in a hole so as to obtain a bearing at both ends, an internal necking or recessing tool of the type shown in Fig. 16 is used. This tool consists of a base *A*, which is clamped to the turret slide, as shown, and fulcrumed on this base at *B* is the main tool-holder *C*. This holder carries the recessing tool, which is held by a bushing and a clamping screw, as shown. The recessing tool is centered with the hole by means of the adjusting screw *D*, which has a collar head that comes up against the bracket *E* of the holder, and it also is provided with a nut for locking purposes. The shoulder of screw *D* is kept against the bracket by means of coil spring *F*, and after the tool has finished cutting, and the pressure is removed from the holder, the spring returns the tool to the central position. The recessing tool is fed to depth by means of a roller pusher *G* mounted in a bracket *H* attached to the edge of the forming slide, as illustrated. The roller bears against a hardened block that is held by screws to the side of the internal necking tool-holder proper. In using this tool for enlarging, or boring a hole, it is necessary, of course, to so arrange the forming cam that the forming slide will be advanced at the proper moment, dwell until the length of bore has been completed, and then be withdrawn. In recessing for a thread or internal form, it is necessary to advance the turret slide and dwell until the forming slide has been fed in to the required depth.

An internal forming or recessing tool that differs slightly from that shown in Fig. 16 is illustrated in Fig. 11. The design in this case is not quite so elaborate; the tool is operated from the forming slide in a similar manner to that shown in Fig. 16.

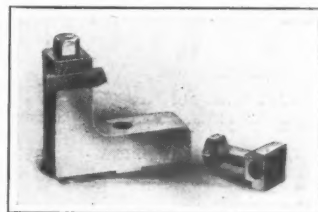


Fig. 14. Knee Turner for Roughing and Finishing Cuts

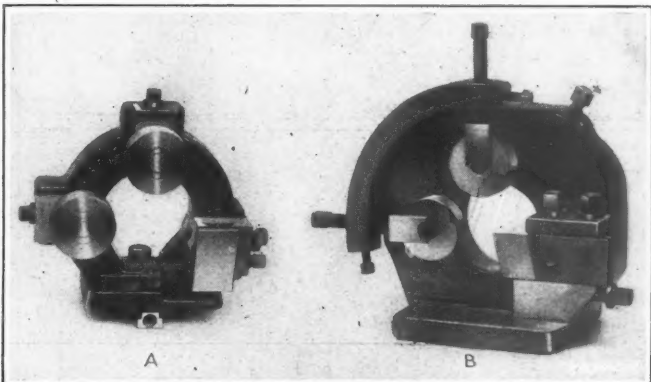


Fig. 15. Standard Turners used on 1 1/4-inch Gridley Automatics

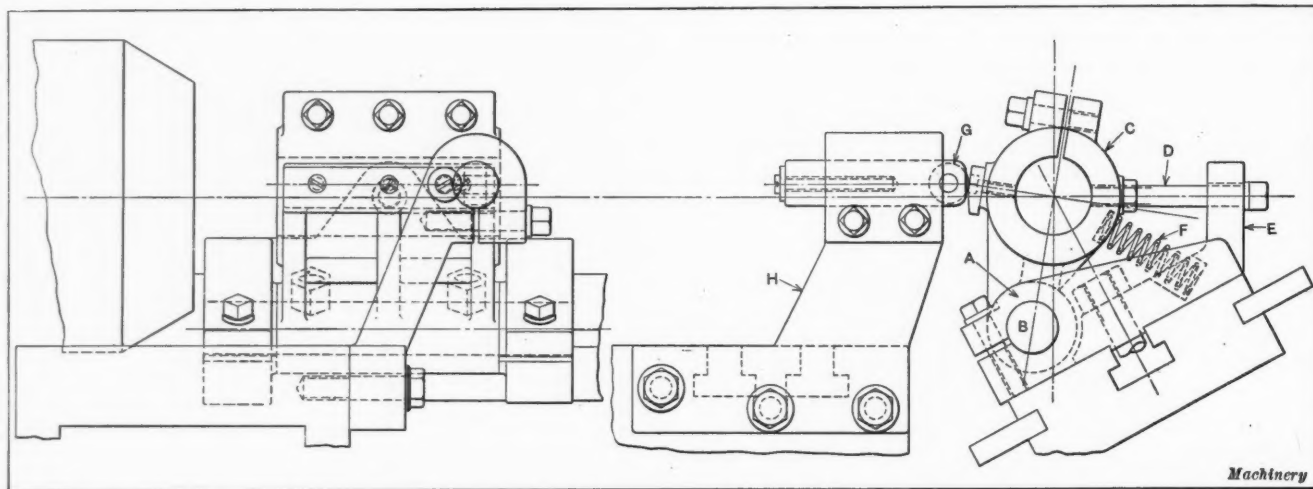


Fig. 16. Another Type of Internal Necking or Recessing Tool-holder

Turners and Back-rests

A noticeable feature of the standard turning tool shown in Fig. 13 is the absence of a shank. This holder is in the form of a yoke having a base that is rigidly clamped to the turret slide. At the front it carries a turning tool and at the rear two supports; the latter can be either of the plain type or of the roller type, as shown. The cutting tool in the turner for the $2\frac{1}{4}$ -inch machine is 1 by $\frac{1}{2}$ inch and is ground on the end, as shown. The roller rests permit the use of heavier cuts and coarser feeds, and a cutting speed of two or three times that which can be maintained when the common type back-rest is used. These back-rests may be used either ahead of or behind the cutting tool, depending upon the character of the work and the cut being taken.

Fig. 17 shows one of these standard turners at work producing a shoulder screw with the forming tool at work at the same time. Forming and turning can be done simultaneously with good results, as the desired rigidity can easily be obtained. This particular setting was used to save time on the single-spindle machine, but if the same job were done on the multiple-spindle machine, two or more turning cuts would be made, thus obviating the necessity for the wide forming cut in the first operation. The same illustration also

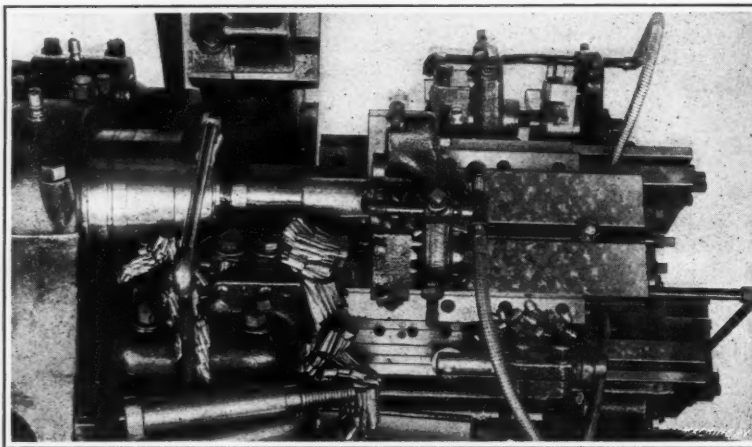


Fig. 17. Standard Turner and Flat Forming Tool working together on Shoulder Screw

shows the adjusting screw for moving the standard tool-holders in a longitudinal direction along the turret slide, to which reference has been made in the foregoing.

At A and B, Fig. 15, are shown two types of standard turners used on the $4\frac{1}{4}$ -inch automatic turret lathe. The one shown at A uses a dovetail turning tool, whereas that illustrated at B uses a forged tool. In both cases adjustable roller supports are used.

Another type of standard turner, known as an "adjustable stud turner," is shown in Fig. 18. This turner is so arranged that three different diameters can be finished at the same time. It consists of a holder proper, which is clamped to the turret slide and carries individual units, one unit for holding the cutting tool and the other for the back-rest or support. Usually the first support of the group is provided with rollers

because of the heavier duty required in this position. The turning tools are adjusted by means of a collar-head screw, as illustrated, and adjustment is also provided for the back-rests.

Fig. 19 shows a special stud turner. This is almost of the same design as the adjustable stud turner, except that it is made for a given piece of work and is not adjustable for shoulder distances, that is, longitudinally. The tool-holder proper is solid, as illustrated, and carries, in this case, five turning

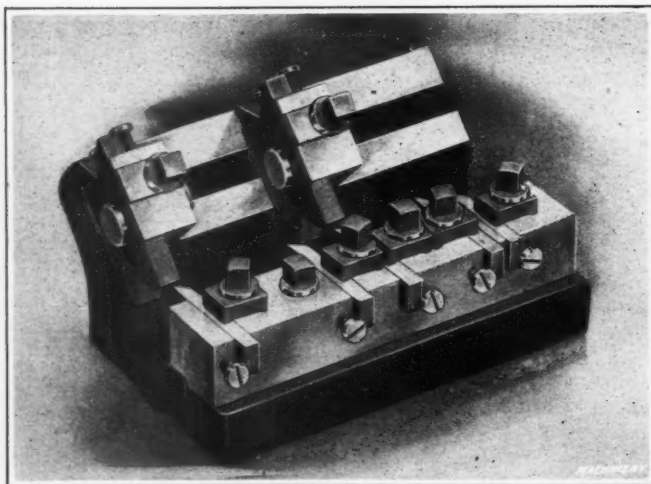


Fig. 18. Standard Type of Adjustable Stud Turner

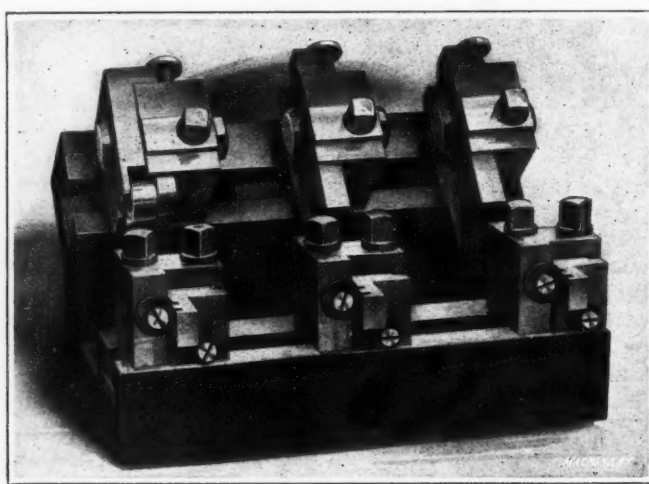


Fig. 19. Special Type of Adjustable Stud Turner

tools. The supports are held so that they can be adjusted along the slide or holder to bring them in the most convenient position relative to the work, that is, where they can give the best support. When the required number of pieces have been made, this tool is put away without disturbing the cutting tools and can be kept until the same piece is to be produced again. In the arrangement shown, it is possible to put the cutting tools much closer together than in the holder shown in Fig. 18.

Knee Turner

Fig. 14 shows a type of tool known as a "knee turner," which can sometimes be used to good advantage for removing scale from the work by preceding the drill, reamer or other tool being used. It is narrow, so that it takes up very little space, and can be used in conjunction with some other tool. It cuts on the back side of the bar, so that the forming tool can be operated without backing off the knee turner from the work to get it out of the way.

Feeds and Speeds for Turning

The feeds and speeds used on the Gridley turret lathe when using the standard turners vary considerably and are governed entirely by the material and nature of the cut. Because of the rigidity of the machine, it is generally advisable to use a coarse feed and a comparatively slow speed. This statement applies especially in the production of studs or other work when the amount of metal to be removed is considerable. When only light cuts are to be taken, however, it is preferable to increase the speed and decrease the feed, although, as a general rule, the speed can be increased without any corresponding decrease in feed and still give satisfactory results, owing to the elimination of chatter. Each different piece, however, requires a careful analysis of the conditions to be met in order to determine exactly what feed and speed should be used.

* * *

GRINDING-WHEEL GRADES

"Grade" is a word used to designate the relative hardness of any given grinding wheel. Different methods of indicating grade are in use, the most common employing the letters of the alphabet. One company uses the first letters of the alphabet for the harder grades, the middle letters for the medium grades, and the last letters for the softer grades. Another company uses just the reverse of this method, while others use a system based upon some particular word. Grade is determined by measuring the resistance which a wheel offers to the penetration of a small steel tool resembling a screwdriver. The wheels under inspection are compared with wheels of known hardness, so that all variable factors are reduced to a minimum. The belief is quite common that a grade is an exact value. A grade is not an exact value—it is a range between limits, and all wheels that come within this range are of one grade and carry the same grade letter. A test was made to determine the hardness of each grade as indicated by the tensile strength. A lot of wheels all of the same dimensions and the same size of grain, but of different grades, were slowly speeded up to a point where centrifugal force became greater than the tensile strength of the wheel, and breakage occurred. The number of points per square inch tensile strength to which each wheel was subjected was calculated, and from these figures the following results were plotted: The tensile strength of grade O, Norton scale, ranges between 2100 and 2050 pounds per square inch; grade N, between the limits of 2050 and 1975; grade M, between 1975 and 1875; grade L, between 1875 and 1790; grade K, between 1790 and 1700; grade J, between 1700 and 1600.—*Condensed from talk by R. G. Williams of the Norton Co.*

* * *

The firm of Isaac Best & Co., Ltd., Newton Heath, Manchester, England, recently made what is claimed to be the longest twist drill ever produced. The length of the drill is seven feet. No statement is made of the object of making so long a drill. The makers are patentees of machines for fluting twist drills and reamers and for backing off such tools, and possibly the drill was made merely for advertising purposes.

THE TUMBLING BARREL

BY G. R. SMITH¹

One of the oldest and simplest metal-working devices, and perhaps the most useful in its field, is the tumbling barrel. Its operation requires but a small amount of power and the attention of one unskilled workman. The idea involved is not of recent date; it is as old as mankind itself, being simply an adaptation of the oldest of all ideas for cleaning. Have you ever seen your grandmother clean the inside of a stained bottle by shaking in it a few small stones and a little water? That is the principle. The Aztecs cleaned and polished their gold trinkets by placing them in a gourd with a little fine sea sand sifted through bits of porous hides and then shaking the gourd until the gold was clean and bright. The trinkets were brought to a still brighter state by replacing the sand with dry fish scales and again shaking. That is the tumbling barrel in its first form; both the idea and the materials used to help the process and get the desired results are old. In a study of the habits and customs of the savage tribes all over the globe, the same idea is found time and time again; we have simply commercialized it for our use.

About the first tumbling barrel of real commercial value was made by an English inventor, William Lee, between 1585 and 1590; it was used to clean the iron and steel parts of a machine for knitting stockings. The idea was speedily adopted until the tumbling barrel became widely known. Lee's barrel was a crude, hand-propelled apparatus, but the idea was brought out in such a way as to show at once its value. The idea involved, however, is not the product of a certain train of thought, as is the case with many inventions, but rather the development of Nature's own bent. Perhaps the simplest people, the crudest minds, received the idea from seeing the stones whirled around in the pot-holes in the rocks of the streams and rivers receiving a polish by the constant motion caused by the flow of water; be that as it may, the idea is old, simple, cheap and effective.

According to the dictionary, the word tumble or tumbling means to fall suddenly, to roll about, to turn over, a rolling over. That explains the process and is exactly what takes place inside the tumbling barrel when it is in motion and what must take place to make the process a success. This is the one factor the writer wishes to bring out more than anything else. Each piece in the barrel rolls and falls over the other pieces, rubbing and chipping off whatever foreign substance may be clinging to the pieces with which it comes into contact. Whatever material, such as sand, sawdust, etc., may be placed in the barrel with the work is only to aid the process of cleaning; the falling motion of one piece over another is what does the work. If sand and cork, or sawdust, are used with heavy steel work, the sand helps the cleaning process, and the cork, or the sawdust, absorbs the dust that comes from the process and in a way helps to polish the work. If sawdust alone is used, it lessens the severity of the blow of one piece against the others and helps the cleaning process.

Cleaning and Polishing Work by Tumbling

In all cases where tumbling is done to clean and polish the work, it is the falling and tumbling of each piece over the others that effects the cleaning and polishing, not the material that is placed in the barrel with the work. The work would clean itself if nothing were mixed with it; therefore, no matter what may be the nature of the work being tumbled, sufficient space must be left in the barrel for it to do its work. Nothing at all will be accomplished if the barrel is filled too full of work or the work mixed with so much sawdust, sand or cork that it is mechanically impossible for the pieces of work to strike against one another. One rule that may be laid down for all classes of work and all sizes of barrels is that the work to be tumbled and the material used to help the process, such as sawdust, etc., should not occupy more than one-third the space inside the barrel, while one-fourth the space is a better ratio to insure success. Many foremen are making a success of tumbling operations by placing in the barrel nothing but the work to be tumbled.

¹Address: 19 Pond St., Pittsfield, Mass.

So varied is the procedure to get different results on different classes of work that it is out of the question to lay down a set of prescribed rules. Small work, such as very thin sheet-brass blanks, copper blanks, etc., should not be tumbled at all. The same result may be secured much more quickly and at less expense by pickling or the bright dip. There should be little necessity for tumbling punched parts of this kind, for if the blanking tools are kept in shape and ground, there will be no burr, and certainly they should not need annealing in the blank. Small brass and copper castings or drop-forgings may, if really required, be cleaned by tumbling in sand.

One cause of failure is the allowance of insufficient time in which to obtain the desired results. All work must be run until thoroughly treated, whether it takes one hour or ten. The operation costs next to nothing, but it must continue until the result is reached. Nothing can hurry the process and the results of six hours' tumbling cannot be expected in one hour. Another cause of poor results or failure is the amount of sand or sawdust used in proportion to the work. In tumbling five cubic feet of work the writer would not mix more than one and one-half to two cubic feet of sand, sawdust or cork. This must be measured by volume, or quantity, and not by weight, as that is another cause of failure; the sand, sawdust and work will weigh in greatly varying proportions.

Copper and brass punched parts are successfully tumbled for burrs in soft-wood sawdust in from two to four hours. Steel and iron parts may be tumbled in sea sand for burrs, scale in annealing, etc., in from three to six hours' run. Burrs and annealing scale have been removed from steel blanks, say 4 to 6 inches in diameter and $\frac{1}{8}$ inch thick, in a five-hour run, with a mixture of sea sand and scrap cork (say two parts cork to two parts sand, by volume, not weight), and this mixture run dry in a ratio of 1 to 4 or 1 to 5 of the steel blanks. Steel blanks 6 inches in diameter and $\frac{1}{8}$ inch thick have been tumbled to a good bright finish in a five hours' run in a barrel of one cubic yard capacity, using one-third as much pure sand as work and the whole load being but three cubic feet. Punched copper commutator segments have been successfully tumbled for burrs in a three hours' run in a barrel of one cubic yard capacity, using one-third as much pine sawdust as work and loading the barrel about half full. Machine-steel punched hinge parts that have been annealed and formed have been tumbled for burr and annealing scale and brought to a bright finish in a six hours' run in a one-cubic-yard barrel, using one-fourth as much pure sand as work and limiting the load to three cubic feet. Green-clay and sand molded castings have been successfully cleaned in a four hours' run in a two-cubic-yard barrel, nothing being placed in the barrel but the castings, and loading to one-third its capacity.

Partly finished or partly polished steel goods are often successfully tumbled in scrap leather to get a higher polish; this is simply an adaptation of the Aztecs' idea of shaking gold trinkets in a gourd with dry fish scales. The waste shavings and dust that come from the manufacture of fiber parts are also used for tumbling steel goods. In fact, all materials used to help the tumbling process should be, and generally are, wastes from other manufactures.

Silver plating has been done in the tumbling barrel by mixing a heavy mixture of chloride of silver, water and common salt with granulated cork. Small brass parts tumbled in this mixture take a very good plate in from one to three hours. The process is simply the rubbing of this mixture on the brass goods by the granulated cork.

The polishing or glaze mill used in the manufacture of rifle powders is nothing but a tumbling barrel. It is a polished, maple-lined barrel, into which is placed a quantity of powder as it comes from the corning mill; the falling motion of each grain over the others gives it the deep glazed luster.

Wooden handles, knobs, etc., are successfully cleaned and smoothed by tumbling with bits of torn sandpaper, a common oil barrel hooked up on a shaft being generally used. The writer has given a good manufacturing finish, in two hours' run in a sixty-gallon oil barrel, with twenty-four sheets, 10 by 12 inches, of torn sandpaper, medium grade, loading the barrel to one-third its capacity. This gives a good finish for dipping in asphaltum or white enamel broken up in gasoline.

Horn goods, clam- and oyster-shell novelties, bone products, etc., are cleaned and polished by tumbling. They are seldom mixed with any other materials.

All woods, most metals and many compositions may be successfully tumbled for cleaning and polishing. The type of tumbling barrel used has little to do with the process, as one barrel is as good as another, except perhaps in convenience. The speed of the barrel is, of course, an important item; it must not be run so fast as to carry the work around in a solid mass, and it must be run slow enough for the pieces to fall and tumble over one another. To be effective, the barrel should make from thirty to sixty turns a minute. Personal judgment and experience must establish the rule in each individual case. In no case should work be tumbled if the same result can be reached more quickly and cheaply by other means, nor should work be dipped, pickled, scratch-brushed or polished that can be satisfactorily tumbled.

* * *

USE OF FORMED SOLDER

In manufacturing articles having many soldered joints difficult to reach, it is good practice to furnish the solder punched or formed to fit the seam, as the time, labor and solder saved are important considerations; moreover, the formed solder is more likely to reach every part of the seam and insure a tight joint.

Fig. 1 shows a solder link stamped from a thin sheet of solder which is used by the Ford Motor Co. in making radia-

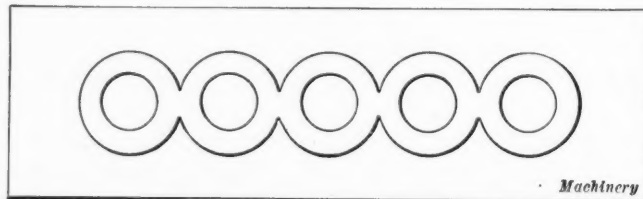


Fig. 1. Solder Link used in making Ford Radiators

tors of the tubular type. The radiator element is built up of vertical rows of tubes pressed through thin copper plates. The ends of the tubes must be soldered tightly into the water chambers. The solder links are dropped over the ends of the rows of tubes and are melted with a blow-torch, as shown in Fig. 2. The solder, being applied all around the tube in link form, runs down the tube to the tube sheet and makes a practically perfect soldered joint on five tubes simultaneously. It is obvious that much time is saved by the use of formed solder links in confined spaces like this; in fact, it would be practically impossible for the workman to apply solder to all the tubes in a reasonable length of time unless it were furnished him in the stamped shape.



Fig. 2. Soldering Vertical Tubes in Water Chambers of Ford Radiators

SPECIAL-PURPOSE TURRET LATHE WITH BALL-BEARING SPINDLE

BY T. S. MACEWAN¹

A heavy-duty, 32-inch turret lathe, recently designed by Charles H. Hollup and built by the Vilter Mfg. Co., Milwaukee, Wis., is shown in Fig. 1. The details of the headstock design

of bearing combination. The machining of parts is simplified and greater ease in erection is secured through the use of ball bearings. Two ball bearings are also located in the three-step cone pulley, which is bored to correspond with the outside diameter of a standard bearing. When running loose, the gear load for the driven gear mounted on the lathe spindle is taken by one of these bearings.

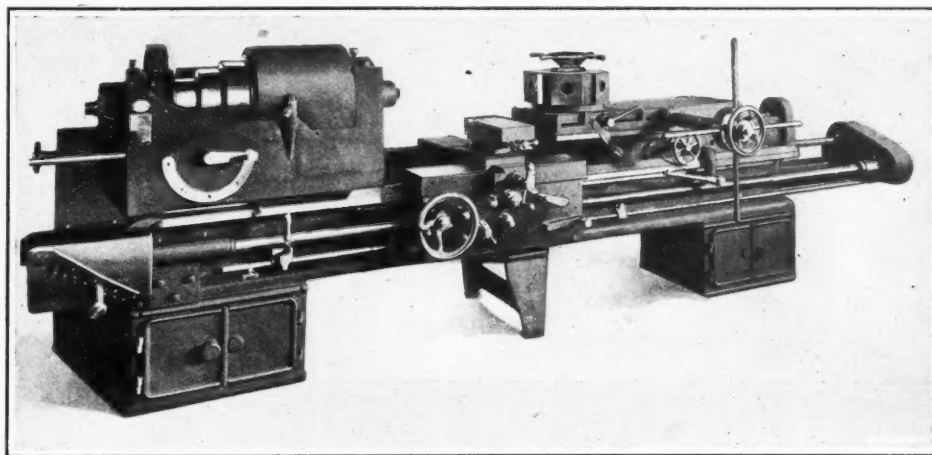


Fig. 1. Heavy-duty 32-inch Turret Lathe

were given the most careful consideration, with the result that ball bearings were used on the spindle and a cone clutch was provided for quickly throwing the back-gears in and out.

A lathe, to be a profitable investment, must be capable of producing properly machined pieces day in and day out with the minimum of attention. This means that the working spindle must be held rigidly and must be free from chatter under operating conditions, and it must be mounted to withstand the tool pressure and thrust imposed. To produce good work, a spindle bearing must be free from shake and hold the spindle tight. A great many people claim that it is impossible to keep a bearing in this condition for any length of time without adjustment, and that wear begins at the time of starting, soon resulting in looseness. While a countershaft bearing, or a bearing for any kind of shaft that does not carry a cutter or work that is being cut, can be slightly loose without serious effect, in a spindle where smooth work is expected, absolute tightness must be preserved. This rigidity of the spindle not only eliminates chatter where heavy cuts are taken with single-point tools, but permits a light finishing cut to be taken with a wide shaving tool. Further, any shake during the cut due to the varying cutting depth of the tool is prevented.

In Fig. 2 it will be seen that the front bearing surfaces of this turret lathe comprise two S K F double-row, radial, self-aligning ball bearings mounted in a through bored housing, with end caps bolted to the frame to make an enclosed type

drives directly through the spindle to the work. The cross-feed screw of the carriage is provided with a thrust ball bearing, by means of which undue wear and the resulting lost motion are eliminated.

* * *

Methods employed in manufacturing are sometimes directly opposite in principle to those that would naturally be followed when making the parts by hand one at a time. These manufacturing methods have been adopted because they overcome difficulties of handling and promote rapid production. For instance, in making motor car top curtains, the Ford Motor Co. follows the practice of sewing the celluloid windows to the fabric before cutting the openings. The fabric holds its shape during the sewing operation and there are no holes to catch on the machine and interrupt the operation. When the sewing is done, the openings are cut with a sharp forked knife which slides over the celluloid and cleanly cuts or rips the fabric close to the seam. This method not only saves the sewing operator's time, but also permits the openings to be cut much more evenly and expeditiously than would be possible by following the reverse and natural process.

* * *

In order that German letters patent issued to American citizens shall not lapse because of the non-payment of taxes, or other necessary fees, a recent presidential proclamation permits such payments to be made throughout the duration of the war.

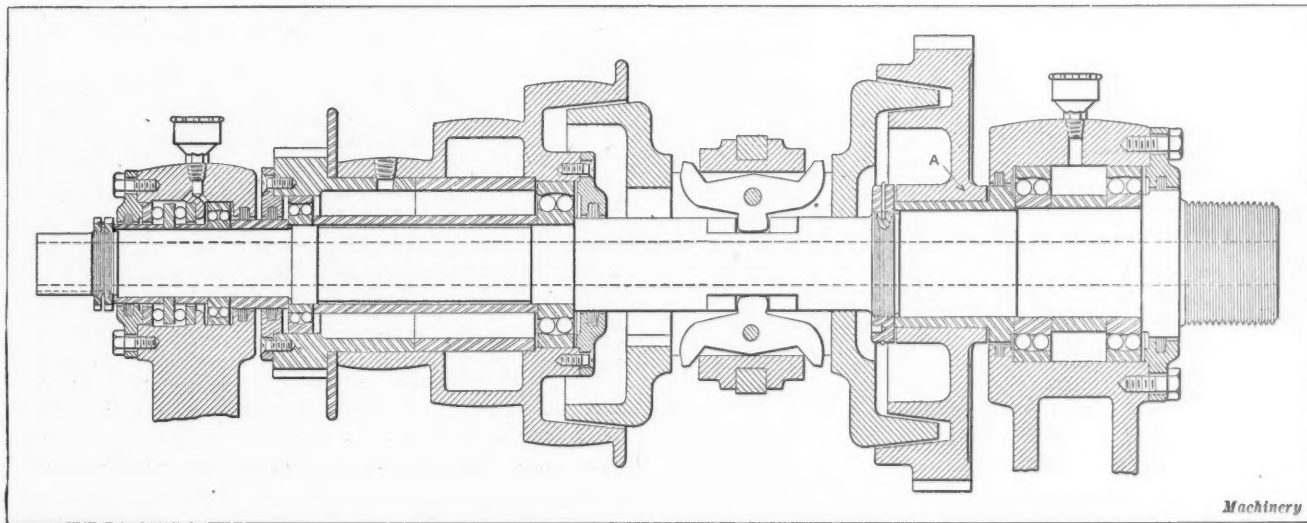


Fig. 2. Spindle of Special-purpose Turret Lathe

¹Address: S K F Ball Bearing Co., Hartford, Conn.

INDUSTRIAL OXYGEN EXPLOSIONS

CAUSES OF RUPTURE OF STORAGE CYLINDERS USED IN WELDING AND CUTTING OPERATIONS

BY EDWARD K. HAMMOND¹

DURING the period in which oxy-acetylene welding and cutting were in process of development, the explosion of an acetylene generator was not an unusual occurrence, accidents of this kind being due to generators of unsuitable design and improper methods of handling the gas. An increase of knowledge on this subject was the means of practically eliminating these sources of danger. Recently there have been several serious explosions of oxygen used in connection with acetylene in the welding and cutting of metals. It has become a matter of general knowledge that acetylene must be handled with care, but many users of oxy-acetylene torches do not realize that there are dangers connected with the use of oxygen of unknown purity, and, as a result, serious accidents are likely to occur. This is due in part to the fact that some manufacturers of electrolytic oxygen generators have unwisely advertised the statement that their machines are fool-proof and can be safely operated by laborers of average intelligence. This may be the case so long as everything goes properly, but it requires a particularly intelligent attendant to detect an abnormal condition of operation before a lot of dangerous gas has been generated and sent out to the welding shop. An inquiry made by *MACHINERY* to ascertain the different sources of danger connected with the use of commercial oxygen or the operation of electrolytic oxygen generators, and the precautions that should be taken to avoid accidents from these causes, has revealed the information outlined in the following article.

In starting upon this discussion, attention is called to the fact that commercial oxygen may be produced by either of two processes. The first is generally known as the liquid air method, which consists of liquefying air by the application of pressure and reducing the temperature, and then separating the oxygen from the nitrogen by taking advantage of the difference in boiling points of the two liquids. Oxygen produced in this way cannot explode through the presence of impurities, because these impurities are nitrogen and other gases which are chemically inert. The second method of obtaining oxygen is by the electrolysis of water, and here there is a possibility of accidents due to hydrogen being present in sufficient quantity to make a mixture that is highly explosive. This danger is theoretical rather than practical, so long as the proper precautions are taken in the operation of electrolytic generating plants; but where there is lack of care in attending to generators or where the generators are of unsuitable design, this danger may prove serious.

Theoretically, the explosion of a mixture of hydrogen and oxygen results in the combination of two volumes of hydrogen gas with one volume of oxygen; but while this is the mixture required for a complete explosion, experience has shown that there is a wide range of mixtures that constitute what may be called a danger zone, i. e., mixtures that may explode

with violence under certain conditions. This question was considered of sufficient importance to warrant an investigation being undertaken at the Pittsburgh Laboratory of the Bureau of Mines, where it was found that mixtures ranging from 9 per cent of hydrogen and 91 per cent of oxygen up to 92 per cent of hydrogen and 8 per cent of oxygen were likely to give trouble. This is more liberal than limits established by the Davis-Bournonville Co., Jersey City, N. J., a well-known manufacturer of welding and cutting equipments, including oxygen generators. In this company's laboratories the danger zone was found to cover a wider range, extending from 6 per cent of hydrogen and 94 per cent of oxygen down to 97 per cent of hydrogen and 3 per cent of oxygen. The idea of this danger zone will be best understood by reference to the tabulated figures, the brackets representing the range of explosive mixtures. Here it will be evident that mixtures of hydrogen and oxygen represented by the high and low limits, and all mixtures coming between these limits, may be made to explode under suitable conditions.

Oxygen	Hydrogen
100	0
98	2
96	4
(94	6
91)	9
8	92
6	94
3	97
2	98
0	100

Note—Brackets inside the columns represent range of explosive mixtures, as determined by Bureau of Mines; and brackets outside the columns cover range of mixtures found to be explosive by the Davis-Bournonville Co.

Investigations conducted with the view of determining the cause of oxygen explosions that have resulted disastrously have led to certain important modifications in the design of electrolytic generators and auxiliary equipments to prevent the recurrence of such accidents. In the operation of an electrolytic cell, decomposition of water results

in liberation of hydrogen at the negative electrode of the cell, while oxygen passes off from the positive electrode. The cells are so arranged that gas collected from each of these electrodes is passed into containers provided for the hydrogen and oxygen, respectively. Should it happen that the polarity of the generator is reversed, it would result in a corresponding reversal of the polarity of the cells, so that oxygen would be collected in the container provided for hydrogen, and *vice versa*.

As a matter of fact, this has been the cause of some serious accidents, and a study of the subject led to the provision of safety devices which make it impossible for trouble of this kind to occur. The safeguard consists of an automatic switch, which makes connection with the electrolytic cells only after the generator has reached normal speed and is developing its normal electromotive force. The necessity for this provision arises from the fact that at any time when the operation of a generator is stopped there is a tendency, while the armature is still turning over by inertia, for a counter-electromotive force to be built up in the cells. This may reach sufficient proportions to overcome the magnetic force of the field windings

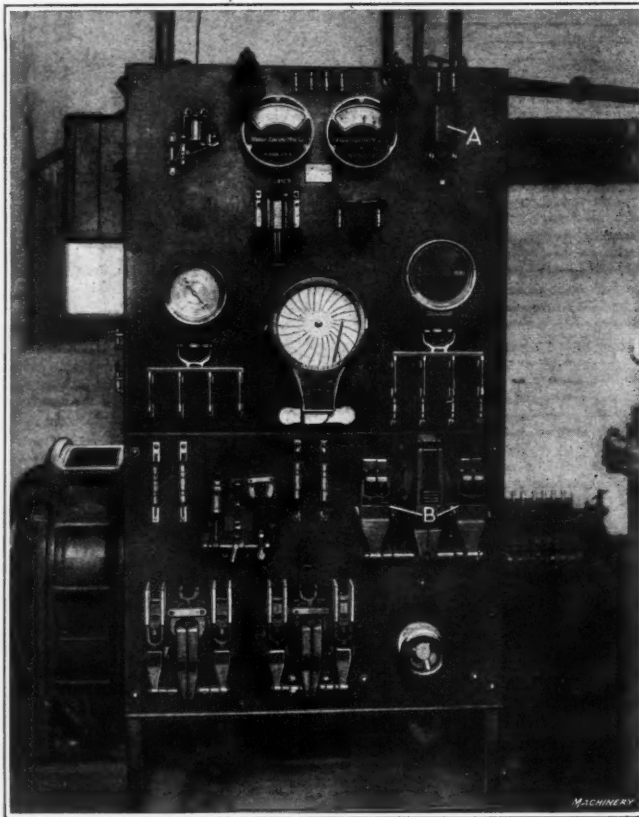


Fig. 1. Switchboard equipped with Automatic Switch to prevent Reversal of Polarity of Generator

¹Associate Editor of *MACHINERY*.

of the generator, so that when it is again started the generator will operate with its polarity the reverse of normal and supply energy of a correspondingly reversed polarity to the electrolyzers.

Should such a condition exist, it is obvious that hydrogen would be delivered to the oxygen gas-holder and oxygen to the hydrogen gas-holder, thus forming a dangerous mixture with the gas already in these holders. But with the automatic switch referred to, there is no danger of this trouble, because the generator will have assumed a normal speed and developed its normal electromotive force before the switch can be closed to allow current to pass through the cells. This method of safeguarding the connecting of the electrolyzers to the power supply makes it impossible for a counter-electromotive force in the cells to overcome residual magnetism in the windings of the generator. In the switchboard illustrated in Fig. 1, the switch shown at A is for making connection between the generator and cells, and is automatically closed by magnetic coils B when the generator speed and voltage have reached the normal figure. When the electric generator is stopped, the circuit through the electrolytic cells is automatically broken.

To further assure against trouble from a counter-electromotive force in the electrolytic cells due to causes outside the plant, such as the reversal of phase in the motor supply circuit, transposition of connections at the electrolytic cells, etc., use is made of a polarized relay connected to a special shunt. This provides for opening a single-pole relay in the control circuit, and the only way in which this circuit may be re-established is to close the relay by hand, provided the polarity has been restored to normal. If a plant is equipped with this system of control, reversal of polarity is indicated by failure of the electrolytic cells to operate. It is important to note that the generator used in connection with electrolytic cells should be of the shunt-wound type, because with compound-wound generators there is greater danger of reversal due to the counter-electromotive force in the cells passing through the series turns.

In addition to danger of the generation of explosive mixtures of oxygen and hydrogen through a reversal of polarity of the generator, trouble may also be experienced through improper connection of the terminals of electrolytic cells. As a

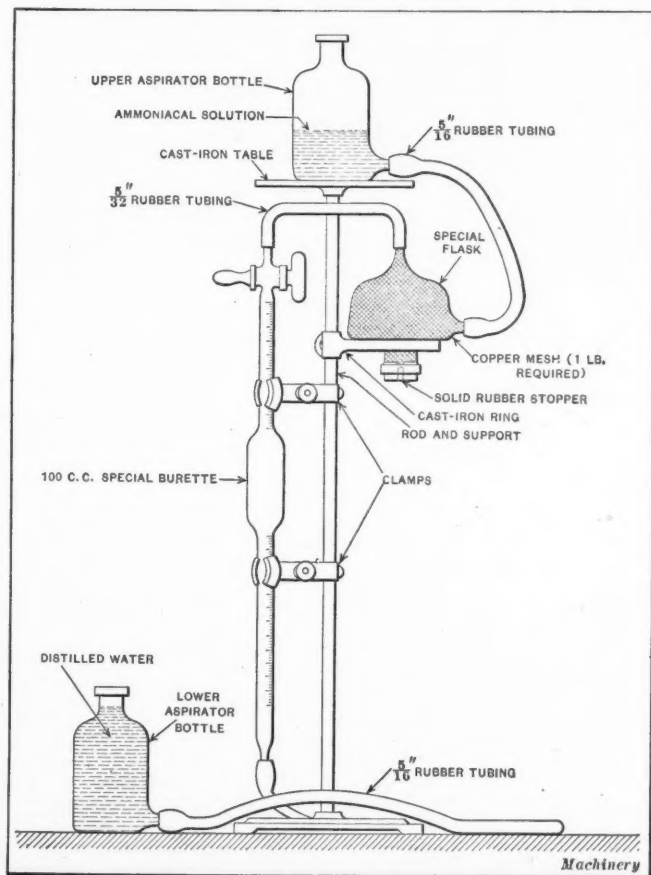


Fig. 2. Apparatus for determining Purity of Oxygen by Absorption with Metallic Copper

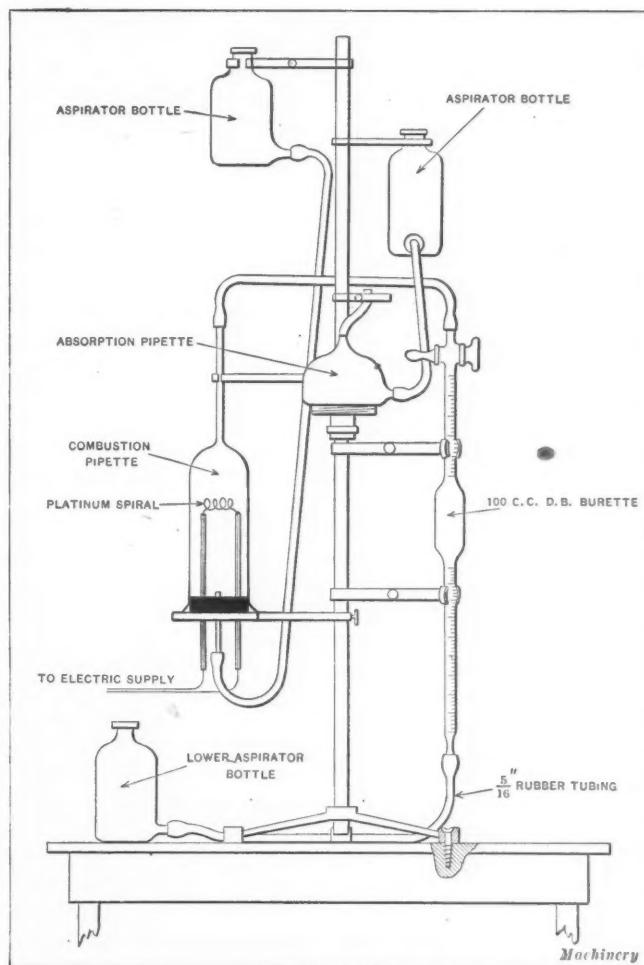


Fig. 3. Apparatus for determining Percentage of Hydrogen by Combustion Method, and Percentage of Oxygen by Absorption with Metallic Copper or Sticks of Phosphorus

matter of fact, this was the cause of a serious explosion which occurred in St. Louis some time ago. With the view of preventing accidents of this kind, the Davis-Bournonville Co. and other manufacturers of electrolytic cells have designed their electrical connections in such a way that it is impossible to connect them with the wrong polarity.

There is only one way to be sure that the purity of oxygen generated in electrolytic cells is up to the required standard, and that is by making chemical analyses at intervals of at least two hours. As a matter of fact, these analyses are simple to make and do not call for extensive technical knowledge of chemistry. Several methods are employed, the most common one being that of measuring one hundred cubic centimeters of gas into a burette and then running this gas over into another burette in which the hydrogen is burnt out by a platinum coil, which is raised to a red heat. The gas is then returned to the first burette and again measured, the contraction in volume expressed in cubic centimeters representing the percentage of hydrogen in the gas.

Other methods of determining the purity of oxygen consist of running the measured volume of gas into a second burette containing either pure metallic copper or sticks of phosphorus. Both these materials have the power to absorb oxygen from the mixture of oxygen and hydrogen, and after this absorption has been completed, the hydrogen is returned to the burette and measured. The contraction in this case represents the percentage of oxygen present. Standard apparatus can be purchased for making all these tests. In practice, it is customary to get a purity of 99.7 to 99.8 per cent for hydrogen and a purity of about 99.5 per cent for oxygen. If the purity of hydrogen runs below 99.5 per cent or the purity of oxygen is found to be below 99 per cent, it is considered that the generator is operating unsatisfactorily, and the man in charge of the station immediately proceeds to look for the cause. Where this precaution is taken, there is little danger of trouble from the use of electrolytic oxygen, because a high factor of safety is provided.

Experience has shown that in the presence of oil there is danger of an oxygen cylinder "exploding" from what may properly be termed "spontaneous combustion" of the cylinder, although the gas is pure oxygen without any trace of hydrogen. This is due to the fact that the action of oxygen under high pressure—usually about 1800 pounds per square inch—results in oxidation of the oil, thus raising the temperature sufficiently to start the oxygen acting upon the iron cylinder, which is burnt away and allows the high-pressure gas to expand rapidly. This could not properly be called an explosion, because an explosion is usually understood to mean rapid combustion accompanied by rapid expansion. However, the condition that exists when the high-pressure oxygen is allowed to expand suddenly is similar to a true explosion, and the results have been serious in some cases. In this connection it is of interest to note that oxygen produced by the liquid air process and oxygen generated in electrolytic cells are equally likely to give trouble. Recently, the statement was made that this source of trouble could be eliminated by substituting graphite as a lubricant in place of oil, but experiments conducted by the International Oxygen Co., the Davis-Bournonville Co. and others show that graphite is just as dangerous as oil.

Still another hypothesis has been advanced as to a source of danger from the explosion of hydrogen. Reference has already been made to the fact that experimental data show that there must be at least 6 per cent of hydrogen in the oxygen to make the mixture explosive. This refers to 6 per cent of hydrogen uniformly mixed through the entire volume of oxygen. Readers of MACHINERY are doubtless familiar with the so-called kinetic theory of gases, otherwise known as the theory of uniform diffusion. According to this theory, the constituents of mixed gases are kept uniformly distributed, due to the kinetic action of molecules of the gas. For instance, a mixture of hydrogen and oxygen containing 3 per cent of hydrogen would have the hydrogen uniformly mixed through the 97 per cent of oxygen, and as it has already been mentioned that a minimum of 6 per cent of hydrogen is required to make the mixture explosive, it will be apparent that there would be no danger with this gas under normal conditions.

In practice, accidents have occurred through the explosion of oxygen cylinders in which the head has been blown out of the cylinder, and investigations conducted to determine the cause of these accidents have led to the belief that under the high pressure which exists in an oxygen cylinder—amounting to approximately 1800 pounds per square inch—the theory of uniform diffusion is not effective; it is assumed that under these conditions of pressure the gases settle out into strata, according to their specific gravities, the result being that the hydrogen rises to the top of the cylinder. This action may not be complete, but if there were a tendency for such settling out to occur, it could easily result in producing an explosive mixture of hydrogen and oxygen at the top of the cylinder, even though there were not sufficient hydrogen to make the entire mixture explosive. If such conditions can be developed, it is apparent that flashback or other cause of ignition would immediately ignite the mixture and result in the explosion of the gas in the cylinder. The theory is interesting, although it has not been definitely established by a carefully conducted scientific experiment. An accident of the same kind might also be produced through the action of oxygen on the oil used to lubricate the valve.

In handling oxygen cylinders, it should always be borne in mind that the gas is under high pressure, and as a result it requires intelligent care to prevent accidents. Cylinders should not be dropped or handled roughly, and they should not be placed so that they can be easily overturned either by collision with some other object or by the reaction due to the violent escape of their contents through the safety outlet with which each cylinder is provided. The valve regulating devices and other attachments should not be lubricated with oil for reasons to which reference has already been made. Discharge valves should be opened slowly and special care should be taken to avoid twisting or straining the valves by the use of hammers or improper wrenches.

Much valuable information has been gathered by members of the Committee on Production of Electrolytic Oxygen and Hydrogen which has been appointed by the Compressed Gas Manufacturers' Association, Inc., 120 Broadway, New York City, concerning possible dangers connected with the use of oxygen in the operation of cutting and welding torches. Distribution of information concerning the proper way to use oxygen and the safeguards that should be taken to avoid accidents will doubtless be the means of overcoming much trouble from this source.

* * *

TAPER MACHINE REAMERS

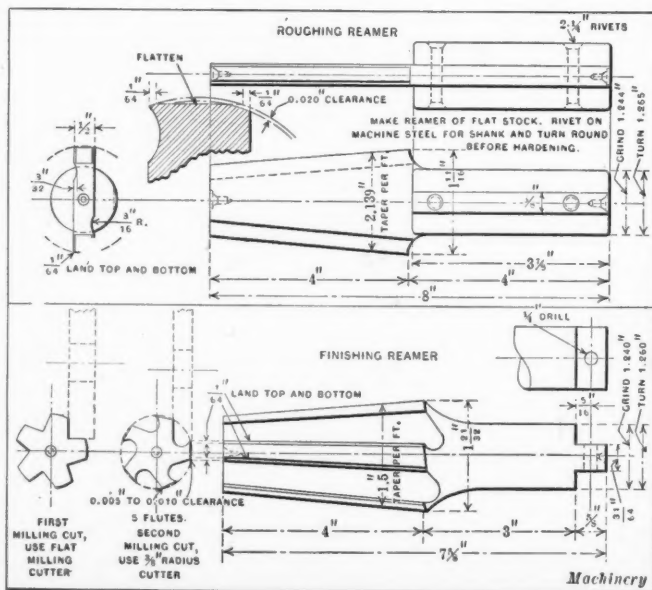
The taper machine reamers shown herewith have been successfully used by the Brown-Lipe-Chapin Co., Syracuse, N. Y., by whom they were developed. The roughing reamer has two cutting edges, and the main body is made from a flat bar of steel, approximately $\frac{1}{2}$ inch thick. After being cut to length, it is centered and turned to the desired contour. Two flat pieces of machine steel are riveted to the body to form the shank, and turned, leaving a sufficient amount for grinding. The chief difference between this taper roughing reamer and other types is the way in which it is ground and backed off. Just in front of the cutting edge a liberal radius is milled to a depth of $\frac{3}{32}$ inch. This not only gives adequate clearance, but furnishes a well shaped surface for chips to slide upon. The taper is first ground accurately until the large end is of the correct diameter. After this, the curvature of the two flutes is flattened, leaving only $\frac{1}{64}$ inch of the curved surface produced by grinding. Next the reamer is oscillated on the centers by hand and a clearance is ground radially on the edge back of the flute. The clearance in this case is 0.020 inch, as shown in the upper view of the illustration.

Finishing Reamer

The finishing reamer is five-fluted and is milled from a solid forging. Two cutters are used in milling the reamer. The first is a plain right-angle cutter, which is followed by one of $\frac{3}{8}$ inch radius. The latter produces the under-cut, which makes these reamers so effective. After the reamer is ground, the flutes are flattened the same as in the roughing reamer. The radial clearance, however, on the back of each tooth is less than in the former case, varying from 0.005 to 0.010 inch. This reamer is fitted at the driving end so that it may float freely when in use.

An advantage that these reamers have over many others is the fact that they actually cut the metal rather than scrape it. Another advantage is the fact that it is impossible to crowd the reamers into the work enough to damage them, since the clearance is a known factor. The economy of the construction of the roughing reamer is worthy of note because of the high price of steel.

V. B.



Details of Roughing and Finishing Reamer

PUMPS FOR OPERATING HYDRAULIC PRESSES

FORMULAS FOR DETERMINING SIZES OF ONE-, TWO- AND THREE-PLUNGER PUMPS

BY A. LEWIS JENKINS¹

THE pressure required on the ram of a hydraulic baling press increases as the density of the bale increases. The pressure at the beginning of the stroke depends upon the density with which the material is packed in the baling box, and at the end, upon the amount that the bale is compressed. A similar variation takes place throughout the run of an unbalanced hydraulic lift, the required pressure increasing directly as the run of the ram.

Presses for baling cotton, hay and similar materials are usually supplied with water or some other liquid by a belt- or motor-driven pump. The speed and width of the belt are constant, and this means that there is a constant amount of power available, and the plungers of the pumps run at a constant speed. When the pump is provided with only one plunger, its diameter or area is determined by the final pressure required, its velocity and the available horsepower obtained from:

$$\text{H.P.} = \frac{pvz}{33,000 \times 12}$$

where H.P. = available horsepower;

p = maximum or final pressure in pounds per square inch;

v = velocity of plunger in inches per minute;

z = area of ram in square inches.

At the beginning of the stroke of the press ram, a very low pressure is sufficient to move it. Hence, it will be seen from the preceding equation that the power required to deliver the water at the beginning of the ram stroke is very small compared with the power required in producing the final pressure; and the time for one operation is much longer than it would be if the maximum available horsepower could be utilized throughout the entire stroke. This condition could be realized for all positions of the stroke of the baling press if it were possible to make pv a constant, where p is the pressure at any position of the stroke. This has been done to some extent by using a mechanism similar to the Stephenson link, which varies the length of stroke of the pump, making it shorter as the pressure increases, and thereby maintaining a constant required power. Other methods have been tried, such as placing two pump plungers in the same plunger box and adjusting their relative positions by shifting their eccentrics in such a way as to vary the effective displacement. The design of a pump which maintains a constant value of pv is more or less complicated, and such pumps are expensive to construct. The result is obtained by automatically varying the length of stroke or by changing the relative positions of the two plungers working in the same plunger box.

¹Address: Department of Mechanical Engineering, University of Cincinnati, Cincinnati, Ohio.

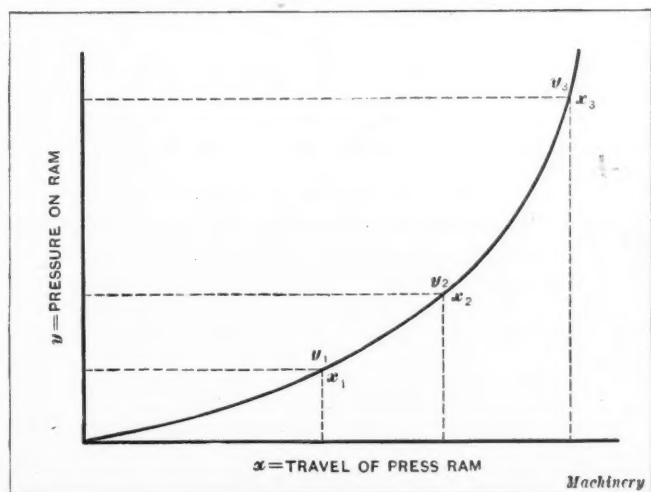


Fig. 1. Diagram illustrating Relation between Pressure of Pump Plungers and Travel of Ram of Press

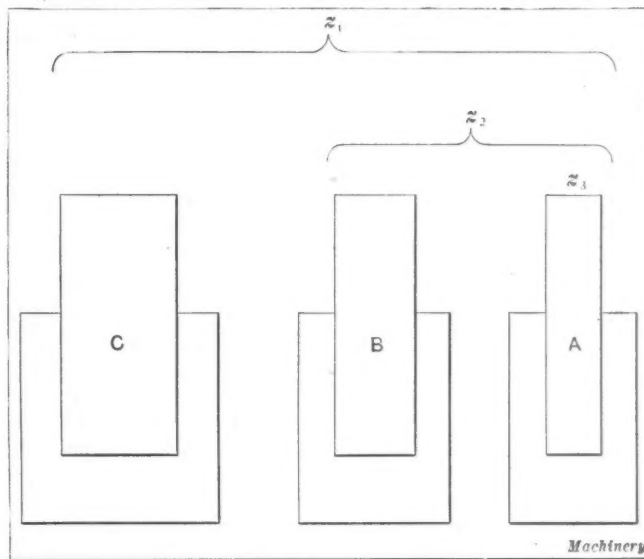


Fig. 2. Arrangement of Multiple-plunger Pump

Another method of maintaining a constant horsepower throughout the stroke of the press is effected by making pz constant; but this cannot be thoroughly accomplished in a commercial machine. An approximation of this method, however, has proved to be the most satisfactory solution. The time required for one operation may be decreased by using more than one plunger and automatically cutting out one at a time as the increasing pressure raises the power required to drive the pump with the active plungers in operation. Thus, a pump provided with three plungers having areas A , B and C , respectively, may have all three plungers in operation for a portion of the stroke of the press ram, and when the pressure times the area of all three of the plungers becomes sufficient to require all the available power, plunger C "knocks out" and A and B continue to operate until the power again becomes equal to the maximum and B "knocks out," allowing the plunger A to finish the operation, which requires the maximum pressure.

All of the plungers A , B and C may be made equal in area, and the pressure at which they should knock out may be determined; but for ordinary baling operations this is not the most economical proportion of plunger areas from the standpoint of available power and the time required to compress a bale. For baling cotton and similar materials the relation between the pressure per square inch on the ram and the travel of the ram in inches may be expressed by the equation:

$$y = kx^3$$

where y = pressure per square inch of the water acting upon the ram of the press after it has traveled a distance x from the beginning of the stroke, and k is a constant depending upon the area of the platen and nature of the material pressed.

Proportions of Plungers for Three-plunger Pump for Baling Cotton

It is desirable to have the plungers of such proportions that they will raise the ram of the press in a minimum time when a given power is available. The relation between pressure y and travel x is shown in Fig. 1, and a diagram showing the arrangement of the plungers of the pump is shown in Fig. 2.

Let z_1 = area in square inches of the three plungers A , B and C ;

z_2 = area in square inches of the two plungers A and B ;

z_3 = area in square inches of the plunger A ;

v = velocity of the plungers in inches per minute;

y_1 = pressure in pounds per square inch at which C knocks out;

y_2 = pressure in pounds per square inch at which B knocks out;

- y_3 = pressure in pounds per square inch at which A knocks out, or the final pressure required;
 x_1 = distance in inches ram of press has traveled when C knocks out;
 x_2 = distance in inches ram of press has traveled when B knocks out;
 x_3 = distance in inches ram of press has traveled when A knocks out, or total travel of press ram;
 M = area of press ram in square inches;
 t_1 = time in minutes the plunger C operates, or time the area z_1 is in action during working stroke of the press ram;
 t_2 = time in minutes the area z_2 is in action during the working stroke of the press ram;
 t_3 = time in minutes the area z_3 is in action, or the period during which only the ram A is operating during the working stroke of the press ram;
 T = total time in minutes required for the working stroke of the press ram = $t_1 + t_2 + t_3$.

The volume displaced by the press ram for any position, a distance x from the beginning of the stroke, is Mx . The volume displaced by area z_1 of the pump plungers for a travel x_1 of the press ram is Mx_1 . The pump plunger area z_2 is in operation while the press ram travels from x_1 to x_2 ; hence, the volume displaced by z_2 is equal to $M(x_2 - x_1)$. Similarly, the volume supplied by z_3 is $M(x_3 - x_2)$.

Substituting the values of x given by the following equation:

$$y = kx^3 \text{ or } x = \sqrt[3]{\frac{y}{k}}$$

we have:

$$Mx_1 = M\sqrt[3]{\frac{y_1}{k}} = \text{volume supplied by area } z_1;$$

$$M(x_2 - x_1) = M\left(\sqrt[3]{\frac{y_2}{k}} - \sqrt[3]{\frac{y_1}{k}}\right) = \text{volume supplied by area } z_2;$$

$$M(x_3 - x_2) = M\left(\sqrt[3]{\frac{y_3}{k}} - \sqrt[3]{\frac{y_2}{k}}\right) = \text{volume supplied by area } z_3.$$

The time t in minutes required to raise the press ram a distance x with one plunger having an area z and velocity v is:

$$t = \frac{\text{volume displaced by press ram}}{\text{rate of flow of water from pump}} = \frac{Mx}{zv}$$

By substituting the value of x given by the equation

$$x = \sqrt[3]{\frac{y}{k}}$$

we get:

$$t = \frac{M}{zv} \sqrt[3]{\frac{y}{k}} = \frac{m}{z} \sqrt[3]{y}$$

where $m = \frac{M}{v\sqrt[3]{k}}$ = constant;

Similarly,

$$t_1 = \frac{m}{z_1} \sqrt[3]{y_1} = \text{time area } z_1 \text{ is in action}$$

$$t_2 = \frac{m}{z_2} (\sqrt[3]{y_2} - \sqrt[3]{y_1}) = \text{time area } z_2 \text{ is in action}$$

$$t_3 = \frac{m}{z_3} (\sqrt[3]{y_3} - \sqrt[3]{y_2}) = \text{time area } z_3 \text{ is in action}$$

Hence, the total time T required to raise the press ram is:

$$T = t_1 + t_2 + t_3 = \frac{m}{z_1} \sqrt[3]{y_1} + \frac{m}{z_2} (\sqrt[3]{y_2} - \sqrt[3]{y_1}) + \frac{m}{z_3} (\sqrt[3]{y_3} - \sqrt[3]{y_2}) \text{ minutes}$$

In order to have the power equal at pressures y_1 , y_2 and y_3 :

$$y_1 z_1 = y_2 z_2 = y_3 z_3$$

By multiplying the numerators and denominators of respective terms on the right of the equation for T by y_1 , y_2 and y_3 gives:

$$T = \frac{m y_1}{z_1 y_1} \sqrt[3]{y_1} + \frac{m y_2}{z_2 y_2} (\sqrt[3]{y_2} - \sqrt[3]{y_1}) + \frac{m y_3}{z_3 y_3} (\sqrt[3]{y_3} - \sqrt[3]{y_2})$$

Since the denominators of these fractions are equal:

$$\frac{T}{m} = \frac{y_1 \sqrt[3]{y_1} + y_2 (\sqrt[3]{y_2} - \sqrt[3]{y_1}) + y_3 (\sqrt[3]{y_3} - \sqrt[3]{y_2})}{y_1 z_1}$$

But

$$y_1 = \frac{y_2 z_2}{z_1} = b y_2$$

and

$$y_2 = \frac{y_3 z_3}{z_2} = a y_3$$

where

$$b = \frac{z_2}{z_1} = \frac{A}{A+B+C}$$

and

$$a = \frac{z_3}{z_2} = \frac{A}{A+B}$$

Substituting the values of y_1 and y_2 in the above equation gives:

$$T = \frac{m}{y_3 z_3} (y_3^{\frac{4}{3}} b^{\frac{1}{3}} + y_3^{\frac{4}{3}} a^{\frac{1}{3}} - a b^{\frac{1}{3}} y_3^{\frac{4}{3}} + y_3^{\frac{4}{3}} - y_3^{\frac{4}{3}} a^{\frac{1}{3}})$$

Simplifying this equation, we get:

$$T = \frac{m y_3^{\frac{1}{3}}}{z_3} (b^{\frac{1}{3}} + a^{\frac{1}{3}} - a b^{\frac{1}{3}} + 1 - a^{\frac{1}{3}})$$

The relation of a to b that will give a minimum value of T may be found by making $\frac{dT}{da} = 0$ and $\frac{dT}{db} = 0$, and solving the two resulting equations as follows:

$$\frac{dT}{da} = \frac{m y_3^{\frac{1}{3}}}{z_3} \left(\frac{4}{3} a^{\frac{1}{3}} - b^{\frac{1}{3}} - \frac{1}{3 a^{\frac{2}{3}}} \right) = 0$$

Since $\frac{m y_3^{\frac{1}{3}}}{z_3}$ is not = 0

$$\frac{4}{3} a^{\frac{1}{3}} - b^{\frac{1}{3}} - \frac{1}{3 a^{\frac{2}{3}}} = 0$$

$$\frac{dT}{db} = \frac{m y_3^{\frac{1}{3}}}{z_3} \left(\frac{4}{3} b^{\frac{1}{3}} - \frac{a}{3 b^{\frac{2}{3}}} \right) = 0$$

Hence

$$\frac{4}{3} b^{\frac{1}{3}} - \frac{a}{3 b^{\frac{2}{3}}} = 0$$

$$4b = a$$

By substituting $a = 4b$ in the equation:

$$\frac{4}{3} a^{\frac{1}{3}} - b^{\frac{1}{3}} - \frac{1}{3 a^{\frac{2}{3}}} = 0$$

$$a = 0.474 \text{ and } b = 0.1185$$

From the equation:

$$a = \frac{A}{A+B}$$

$$B = A \left(\frac{1-a}{a} \right)$$

From the equation:

$$b = \frac{A}{A+B+C}$$

$$C = \frac{A}{b} - A - B = \frac{A}{b} - A - A \left(\frac{1-a}{a} \right)$$

$$C = A \left(\frac{1}{b} - \frac{1}{a} \right)$$

By substituting $a = 0.474$ and $b = 0.1185$ in the preceding equation:

$$B = 1.11A \text{ and } C = 6.33A$$

Since the area varies as the square of the diameter, diameter of ram B is $1.05 \times$ diameter of A ; and the diameter of C is $2.52 \times$ diameter A . Hence, for baling a material which obeys the law $y = kx^3$, the diameters of plungers A and B may be made equal and the diameter of C should be about 2.5 times that of A .

Time Required to Form Bale

The time required to run a press ram through its entire stroke when $y = kx^3$ and a three-plunger pump is used, having the diameters of the plungers in the ratio of 1, 1.05 and 2.52, may be found by substituting $a = 0.474$ and $b = 0.1185$ in the equation for total time T , which gives:

$$T = \frac{my_3^3}{z_3} \left(0.1185^3 + 0.474^3 - 0.474 \times 0.1185^3 + 1 - 0.474^3 \right)$$
$$= \frac{0.42my_3^3}{z_3} = \frac{0.42mp^3}{A} = \frac{0.42M}{vA} \sqrt{\frac{p}{k}} = \frac{0.42Mx}{vA}$$

General Case for Three-plunger Pump

The diameters of plungers for pumps designed to operate any baling machine, regardless of the material to be baled, should be based on the assumption that $y = kx^3$. This value may be considered an average for the materials commonly operated upon; but if it is definitely known that a pump is to supply water to a press for compressing any given material, such as tankage, apples, grapes, olives, hay, tin cans, etc., the exact relation between pressure and travel may be easily determined by experiment. The pressure per square inch of the liquid in the cylinder is read from a gage for a number of positions of the ram, and these data plotted on log-log paper or the values of n and k are determined by substituting values of x and y in the equation $y = kx^n$, which may be used for practically any material.

By using $y = kx^n$ instead of $y = kx^3$, it is found for a three-plunger pump that:

$$a = \frac{(n + 1)b}{1}$$
$$\text{and } b = \frac{n - 1}{(n + 1)^2 - n(n + 1)}$$

From these equations, values of a and b and the areas and diameters for given values of n are shown in Table 1.

TABLE 1. RATIOS OF PLUNGER DIAMETERS FOR THREE-PLUNGER PUMP

n	b	a	Area of B Area of A	Area of C Area of A	Diam. B Diam. A	Diam. C Diam. A
1	0.333	2b = 0.666	0.50	1.50	0.70	1.22
2	0.179	3b = 0.549	0.84	3.69	0.92	1.92
3	0.118	4b = 0.474	1.11	6.33	1.05	2.52
4	0.085	5b = 0.429	1.33	9.33	1.15	3.05
5	0.067	6b = 0.406	1.46	12.29	1.21	3.51

General Case for Two-Plunger Pump

In the case of a pump having two plungers with areas A and B , it may be shown that:

$$a = \frac{A}{A + B} = \frac{1}{n + 1}$$
$$\text{from which } B = An$$

The relative values of A and B and their corresponding diameters are shown in Table 2 for different values of n .

TABLE 2. RATIOS OF PLUNGER DIAMETERS FOR TWO-PLUNGER PUMP

n	Area of B Area of A	Diam. B Diam. A
1	1	1.00
2	2	1.41
3	3	1.73
4	4	2.00
5	5	2.24

Determination of "Knock-out" Pressures

The method of finding the "knock-out" pressure is illustrated by the following example: A three-plunger pump having a piston velocity of 50 feet per minute, diameters of plungers 1.5 inch, 1.5625 inch, and 3.75 inches, gives a maximum pressure of 1500 pounds per square inch. The efficiency of the pump is 70 per cent.

The maximum horsepower required is:

$$\text{H.P.} = \frac{1500 \times 50 \times 1.76}{33,000 \times 0.7} = 5.72$$

This is found by using the maximum pressure and the area of the plunger giving that pressure. The maximum horsepower is reached when the product of the pressure into the area is equal to:

$$1500 \times 1.76 = 2640$$

The area of all three plungers is $1.76 + 1.91 + 11.04 = 14.71$ square inches, which gives $\frac{2640}{14.71} = 180$ pounds per square

inch for the first "knock-out" pressure. The sum of the areas of the second and third rams is $1.76 + 11.04 = 12.80$ square inches, and the second "knock-out" pressure is $\frac{2640}{12.80} = 206$ pounds per square inch.

These pressures are lower than those generally found on pumps for baling presses; but in view of the fact that fibrous materials, such as cotton, approximately compress according to the equation $y = kx^3$, and the ram is at $\sqrt[3]{\frac{180}{1500}} = 0.49$ and $\sqrt[3]{\frac{206}{1500}} = 0.52$ of its total run when these pressures are attained, the advantage of the low "knock-out" pressures is readily appreciated.

IGNORANCE IN STARTING A MANUFACTURING BUSINESS

A large percentage of business failures are due to the lack of knowledge of the business entered and the equipment and organization required. Men engage in retail selling with little or no business experience. They buy goods unwisely, acquire ill-balanced stocks, and finally fail with a lot of bad accounts which can never be collected. The manufacturing business is no exception to the rule, and many heedless, ill-advised ventures are often met with in manufacturing. It is stated by a machine tool salesman of broad experience in selling new machinery and dealing in second-hand tools that a large percentage of the men who start small manufacturing enterprises know practically nothing of manufacturing principles and are almost totally ignorant of the equipment required to produce their products efficiently. They buy lathes, planers, drilling machines, milling machines, and other standard machines with little discrimination and set them up in orderly rows in their new quarters. Power is turned on and the wheels start in motion, but machinery running does not necessarily result in turning out marketable carbureters, gas engines, egg beaters or anything else. The important elements of directive skill and sales organization are too often lacking. After struggling along miserably for a few months, a lot of machine tools, somewhat the worse for wear, are offered to second-hand dealers.

ENGINEERING COUNCIL

The first meeting of the Engineering Council was held in the Engineers' Bldg., New York City, June 27. This body is a department of the United Engineering Society and has recently come into being as a medium of cooperation between the four national engineering societies. The function of the council is to speak authoritatively for all member societies on all public questions of a common interest or concern to engineers. It is composed of twenty-four members, five being appointed from each of the four founder societies and four by the United Engineering Society; the founder societies are the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. At the organization meeting, Dr. I. N. Hollis was elected president of the council; H. W. Buck and George F. Swain, vice-presidents; and Calvert Townley, secretary. Ways and means were discussed by which the societies through the council might be of use to the national government. A resolution was adopted instructing the executive committee to cooperate with the government in procuring the services of engineers, and a committee was appointed to consider the best means of utilizing the inventive ability of members of the founder societies.

Factory Transportation-2

by Edward K. Hammond¹



MOTOR-DRIVEN trucks, provided with their own power plant in the form of an electric storage battery and motor, are now being used in many industrial plants in the United States. Trucks of this type naturally cost considerably more than any of the trucks which are driven by manual labor, and the only justification for investing in equipment where the first cost is higher is if conditions of operation are such that a greater amount of service might be obtained from motor-driven trucks. It is difficult to make statements to cover general conditions, but in the present case it may be stated that the particular field of usefulness of motor-driven trucks is where the length of haul is sufficiently great so that a material saving of time and labor may be obtained through the increased speed. Running on hard level surfaces, the speed of these trucks will be about seven miles an hour, and the average truck has a capacity for running about twenty-five miles on a single battery charge.

The driver stands erect on a platform at the end of the truck, with his hands on the controller and steering levers, respectively, and one foot on the brake pedal. Simplicity of operation does away with the necessity of hiring high-priced operators for these trucks. Where motor-driven trucks can be

¹Associate Editor of MACHINERY.

kept busy, the General Vehicle Co. of Long Island City, N. Y., claims that with hauls ranging from 200 to 800 feet each truck will take the place of from four to six men. An idea of the rate at which these trucks operate will be gathered from the fact that a time study made in unloading bags of cement at a New York pier showed that it took thirty minutes to unload thirty-eight bags of cement and transport them a distance of 500 feet, where four men were employed operating hand trucks. With an electric truck, two men handled seventy similar bags in seventeen minutes and carried them 750 feet instead of 500 feet. It is not claimed that any such saving may be expected in all cases. There are many classes of work where better results will be obtained with hand trucks; but for those classes of service for which motor-driven trucks are adapted, they give highly satisfactory results.

A manufacturer who contemplates the installation of motor-driven trucks will naturally ask himself, "What will it cost to operate such equipment?" For the benefit of such men it may be stated that the average cost of running an electric truck and the necessary charging equipment—including maintenance, interest, depreciation, taxes, insurance and charging current—is \$2.50 per working day, exclusive of operator's wages. A single charge of the battery during the preceding

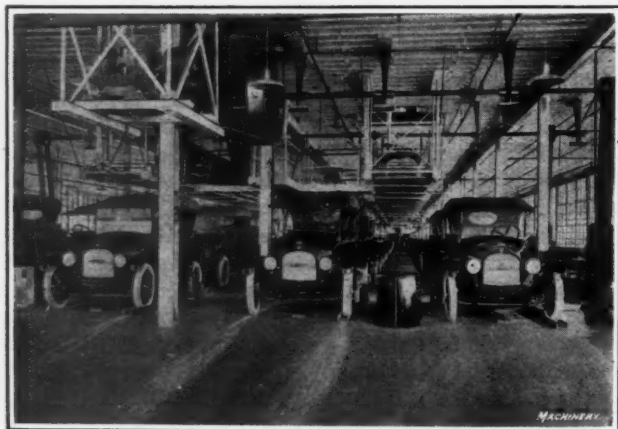


Fig. 55. Progressive assembly of automobiles has been developed to a high degree by engineers of the Willys-Overland Co. Four assembling tracks are provided in the factory, down which cars are run, and conveyors running at right angles to these tracks carry all the different parts to the assemblers. This system has been brought to a high degree of perfection and work is handled very rapidly

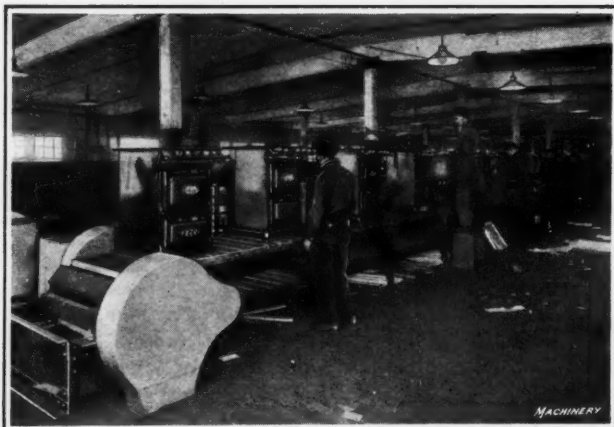


Fig. 56. The benefits secured by progressive methods of assembling in automobile factories have been so marked that this method is now finding application in other industries. The Detroit Stove Works is making use of a conveyor system installed in its plant by the Palmer-Bee Co. of Detroit, Mich., for use in the progressive assembly of gas ranges

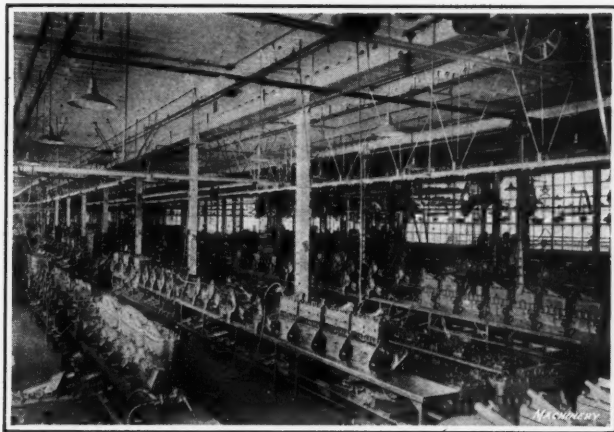


Fig. 57. Overhead conveyors are used in the motor assembling department of the Willys-Overland Co., Toledo, Ohio, for carrying the larger parts of the motors to the assembling benches. Small parts are held in New Britain tote boxes underneath the benches, where they are within convenient reach of the operator



Fig. 58. In the Ford Motor Co.'s plant every possible saving is effected in production. In assembling motors, as fast as one man finishes his task he pushes the motor along to his companion and receives a new motor from the man on the other side. This is another example of the progressive method of assembling

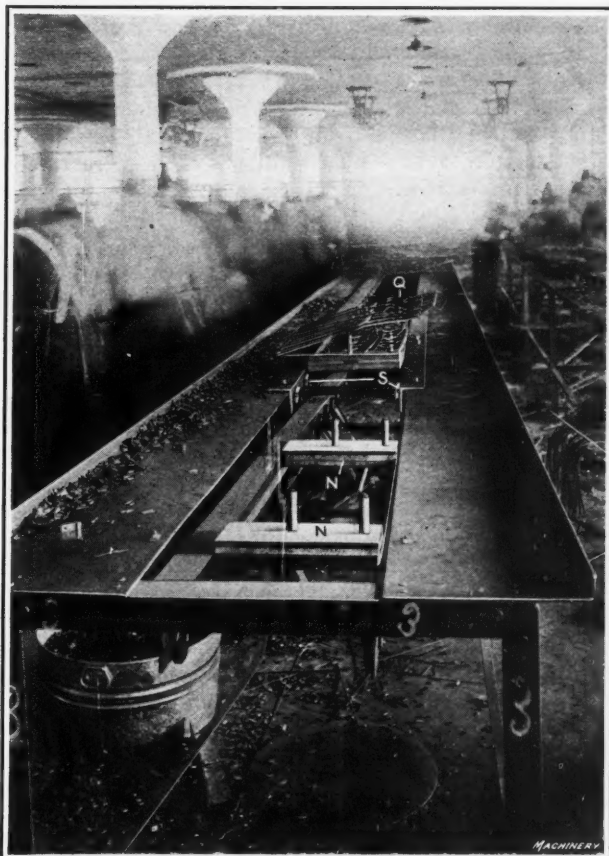


Fig. 59. Progressive methods of assembling are used in manufacturing automobile cushion springs. In the Detroit Wire Spring Co.'s factory, the Palmer-Bee Co. has installed equipment for handling this work. The spring frames are placed on small trucks, on which they are carried along the bench from man to man, and the various parts of the spring are put together



Fig. 60. The Palmer-Bee Co. of Detroit, Mich., makes a specialty of designing and installing time- and labor-saving equipments for handling material in course of manufacture. This illustration shows an outfit installed by this company for assembling automobile transmissions. Two strands of endless chain carry brackets which support the work at each end

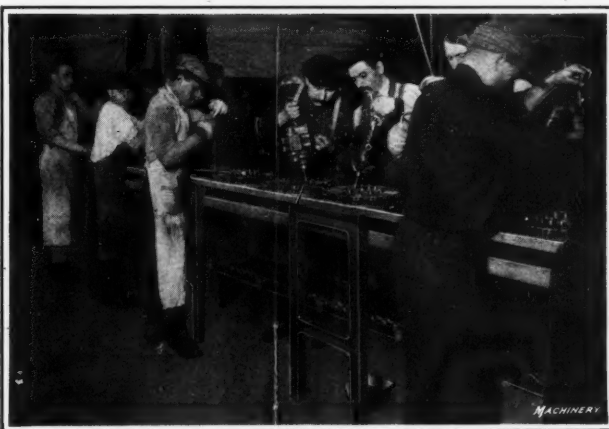


Fig. 61. In this case the magnetic generator unit of the motor is carried on an endless belt conveyor, and men with power-driven wrenches are screwing up the nuts. Attention is called to the large number of men at work; this is typical of the intensive production methods in the Ford Motor Co.'s shops

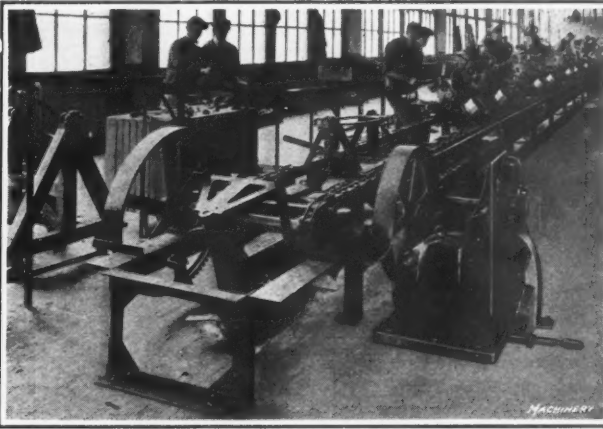


Fig. 62. Formerly the Packard Motor Car Co. assembled clutch units on stands that were distributed over the floor of the clutch assembling department. The Palmer-Bee Co. suggested that the progressive method of assembly be employed in handling them, so a conveyor system was installed, which carries stands similar to those formerly employed



Fig. 63. Where it is necessary to transfer work from an upper floor in a building to an upper floor in another building, much time is lost in taking the work down and up in elevators in the ordinary way. Sometimes it is possible to have a conveyor carry the work right across from one building to the next, as here shown



Fig. 64. In the Studebaker Corporation's factory in Detroit it is necessary to transfer automobile frames from one building to a floor two stories higher up in an adjacent building. For this purpose a conveyor system was installed by the Palmer-Bee Co. It consists of a structural steel frame with rails, over which the automobile frames are pulled by an endless chain conveyor



Fig. 65. Factories engaged in building heavy machinery, structural iron work, etc., find it necessary to have cranes for loading finished product onto cars. This illustration shows the work of loading a kerosene tractor onto a flat car. The crane was built by the Northern Engineering Works of Detroit, Mich.

night is sufficient to run the truck with its full load of two tons for 90 to 100 round trips of 1000 feet. Batteries may be charged while in the truck or a complete change of batteries may be made in five minutes. A laborer of average intelligence can be taught to drive one of these trucks in a few hours, and automatic safety control features make it practically impossible to damage the load or for the operator to be injured.

One point that stands out in favor of the use of motor-driven trucks is that when a man can ride, little difficulty is experienced in keeping him at work; but when he is required to pull a heavy truck, which is a tiresome job, he is not likely to stay long. Hence the motor-driven truck may be said to constitute a means of saving employers the expense of breaking in new help. In conclusion, it may be stated that motor-driven trucks may be furnished with flanged wheels for operation on rails, or with rubber tired wheels to travel on the floor. Signal systems of various kinds may be used—such as electric lamps or flags—to show when aisles are clear for the passage of trucks, or when one truck is likely to meet another before reaching the opposite end of an aisle. Electric trucks are built in many designs to meet the requirements of different classes of work. Elevating trucks are made for use in connection with platforms, boxes, etc., and plain trucks are made for carrying loads directly. In addition, there are the so-called tractors designed for pulling one or more cars on which the load is piled.

Demountable Body Trucks

Motor trucks may be employed to advantage in many shops for carrying shipments from a factory to the main line of a railway, shipping dock, etc., or for making quick deliveries within twenty or thirty miles of the plant. Where the tonnage to be handled is large, it may be desirable to use one or more trailers in connection with a truck in order to increase its carrying capacity. A good grade of motor truck is quite costly, and this makes it necessary for the firm employing one or more of these trucks to take advantage of every opportunity to secure the greatest possible return on its investment. One way of greatly increasing the amount of service obtained from motor trucks is to use what are known as "detachable" bodies. Two or more of these bodies may be used in connection with each truck, so that when a truck comes in loaded the removable body can be lifted off and carried away by trolley hoists, after which an empty body is substituted so that it may haul away a new load or go out after a fresh load, as the case may be. While the truck is away from the plant the load brought in on the previous trip—which has been removed with the detachable body—is taken to its destination by the trolley hoist, and the empty body is brought back ready to be exchanged for a full body when the truck returns with its next load. This method is said to be the means of increasing the capacity of motor trucks from 50 to 100 per cent when used under conditions that enable maximum efficiency to be attained. In the case of very heavy loads, the detachable body may be furnished with nests so that the load may be divided to bring it within range of the trolley hoists. In some cases the bodies are mounted on auxiliary casters or wheels upon which they may be moved.

Progressive Machining Operations

Where machining operations to be performed on a given part are of such a nature that a battery of planers, milling machines, drill presses, boring machines, etc., is required to finish a piece, it is of the utmost importance to have these machines so grouped that the work passes continuously from machine to machine without delays. In many well organized factories the equipment has been so arranged that conveyors, trucks or some other form of device can be used to carry the work from machine to machine with the least amount of time and labor.

An example of this kind is seen in the milling operations on aluminum crank-cases in the plant of the Buick Motor Co., Flint, Mich. The first four milling operations are performed on Ingersoll planer-type milling machines, which provide for handling five upper and five lower halves of the crank-cases at

a time. In operation, the table is run forward under the cross-rail, and castings placed ready on the floor are dropped into position in the milling machine fixtures without any attempt to tighten the clamps on the fixtures. Then as the table starts to feed back, the operator starts with the fixtures nearest the cross-rail and tightens up all bolts so that the work is secured for machining. After all the work has been secured, he goes to a position back of the cross-rail and starts taking out the milled cases, which are swung over onto gravity carriers and rolled down to a position ready to go on the next Ingersoll milling machine. In this connection it is important to note that the gravity carriers are made the same height as the milling machine tables so that the work can be transferred from the carrier to the table and *vice versa* with the minimum effort.

A more highly developed method of progressive machining consists of having tracks laid between different machines on which trucks run that support jigs and fixtures for carrying the work. Fig. 38, in the first installment, shows a view in the plant of the Packard Motor Car Co., Detroit, Mich., where crank-cases are being drilled. There are 200 holes to be drilled in these cases and the complete drilling operation is finished in forty-two minutes; the actual drilling time is thirty-eight and one-half minutes and three and one-half minutes are allowed for setting up and removing work from the jig. The machine tool equipment consists of seven Baush multiple-spindle drilling machines with various numbers of spindles and different types of heads, and one radial drilling machine. The jigs are arranged so that they can be pivoted to bring different surfaces of the work into the operating position. Index-pins enter hardened steel bushings in the jigs, locating them accurately for each successive operation, and clamps are provided which secure the jig trucks in place on the tracks. Handled in this way, a high rate of production may be obtained, because the workman is relieved of all physical strain in lifting work on and off machines, it being merely required for him to set the work up in the jig at the beginning of the row and remove it when the job is finished. One workman follows a single casting right down the line, performing all the machining operations required on it.

For boring, milling and other operations where the fixtures are of such a type that it would not be feasible to use a single fixture for a number of operations, a somewhat similar idea may be employed. Instead of having the work and fixture taken from machine to machine on tracks, a roller type conveyor is run parallel to the line of machines, with switches branching off to individual machines, as was illustrated in Figs. 44 and 45 in the July installment. With an equipment of this kind the operator can push a heavy casting along on the conveyor and run it in on the switch to a given machine. The conveyor and the machine table are the same height, so that the operator merely swings the work over from the conveyor and puts it in position in the fixture for machining. When the operation has been completed, the casting is put back on the switch and run up to the main line, upon which it is carried to the switch leading to the next machine. Where this method has been adopted it has been found the means of saving a great deal of time in the performance of machining operations.

Laying Out Gravity Carriers

As the name implies, the pitch of a gravity carrier is relied upon to enable the force of gravity to run the load along the conveyor without the application of power from an external source. In designing this type of equipment it is the practice of the Mathews Gravity Carrier Co., Elwood City, Pa., to make the pitch of conveyors from 2 to 8 per cent, but most of the conveyor systems installed by this company have a pitch of 4 per cent. In the construction of conveyor systems of this type, there is a good deal of variation in the lay-out, according to the nature of the work to be carried. Packages with smooth, flat bottoms may be run on these carriers without guard rails, but where the load is irregular in shape some form of guard rail is necessary.

Various expedients are adopted to keep the load running on these conveyors. The most obvious way is to place a guard

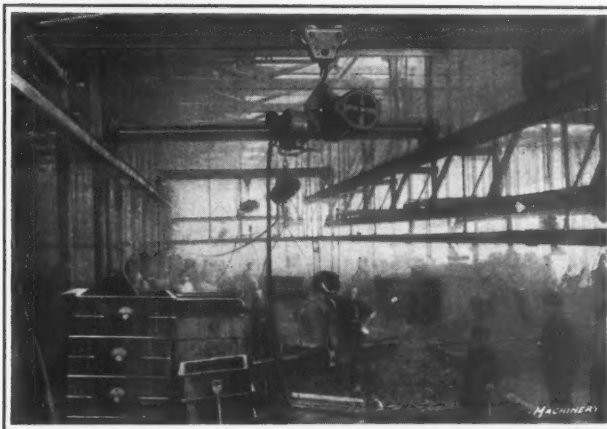


Fig. 66. In foundries where moderate loads are to be handled at fairly frequent intervals, it is convenient to use a crane in which the trolley and bridge are operated by hand, and the hoist is driven by power. Cranes of this type are shown here, equipped with "Imperial" pneumatic motor hoists built by the Ingersoll-Rand Co., New York City.

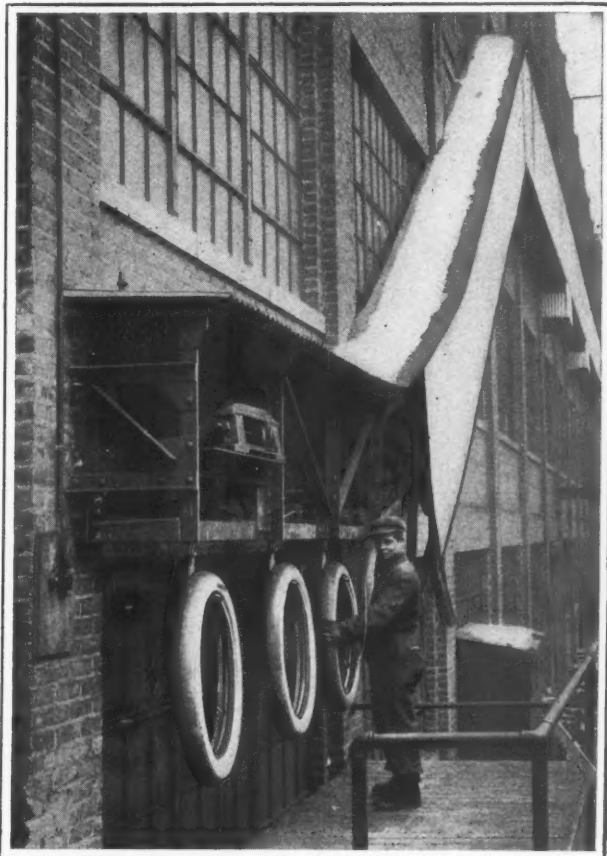


Fig. 67. Where there is considerable congestion in a shop, it may be desirable to hang conveyor systems and similar equipment on the outside of buildings. A case in point is seen in the accompanying illustration, which shows a view of a conveyor system installed in the Studebaker Corporation factory for handling tires, wheels and hubs. The conveyor is an endless chain with hooks for carrying the work.

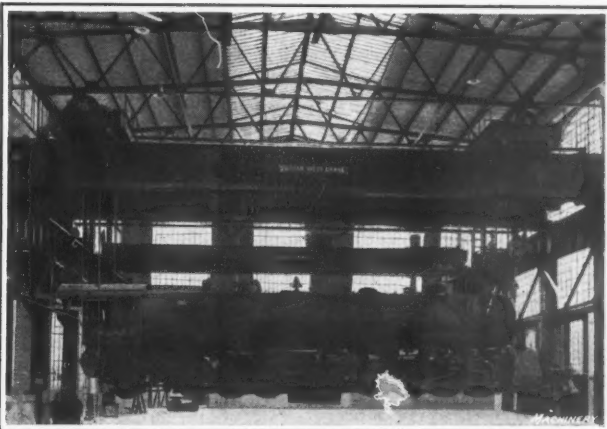


Fig. 68. One 200-ton and one 20-ton electric traveling crane with a span of 75 feet, 6 inches are here shown in use in a railroad shop. These cranes were built by the Niles-Bement-Pond Co., New York City. The weight of the suspended engine is 270 tons. Attention is called to the method of lifting the locomotive from four corners.

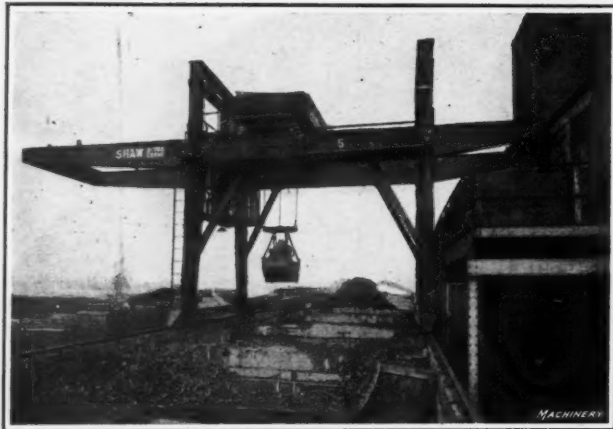


Fig. 69. This illustration shows a bin at the side of the railroad at the Ford Motor Co.'s plant in Detroit for storing coal, coke, limestone, scrap metal, etc. The Shaw Electric Crane Co., Muskegon, Mich., installed a gantry crane equipped with a grab bucket for handling this material

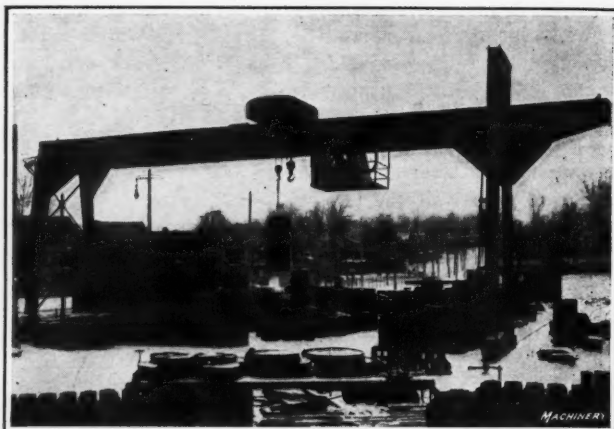


Fig. 70. Gantry cranes are generally used where the amount of service is not great enough to warrant the construction of an overhead runway for a traveling crane. Gantry cranes are more expensive to operate, however, and this may offset the lower first cost. The crane here shown was built by the Northern Engineering Works, Detroit, Mich.



Fig. 71. In large power plants it will often be found necessary to provide special equipment for the handling of fuel, as manual labor is too slow. This illustration shows a monorail bucket hoist built by the Northern Engineering Works for charging coal into boiler hopper storage tanks in a large power plant



Fig. 72. In foundries where there is a lot of sand, coke and limestone to be handled, it will sometimes be found advantageous to employ a grab bucket. This illustration shows a trolley hoist built by the Sprague Electric Works of New York City, equipped with a grab bucket for use in a foundry. Such an outfit operates at a high rate of efficiency

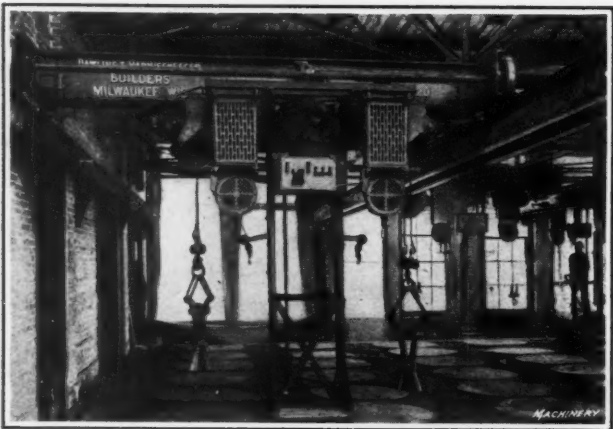


Fig. 73. Crane builders are often called upon to construct special equipments to meet the requirements of various industries. The illustration shows cranes built by the Fawling & Harnischfeger Co., Milwaukee, Wis., especially for handling work in the annealing shop of a car wheel foundry

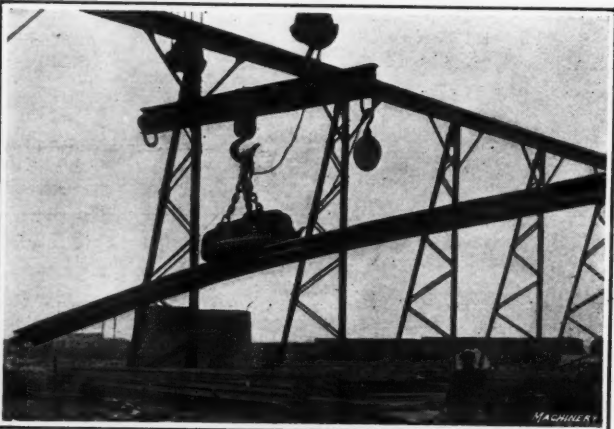


Fig. 74. Lifting magnets are used for handling various iron and steel products. This illustration shows an electromagnet built by the Cutler-Hammer Clutch Co., Milwaukee, Wis., lifting long steel bars. A special arrangement of a beam and two hoists prevents the magnet and its load from rotating

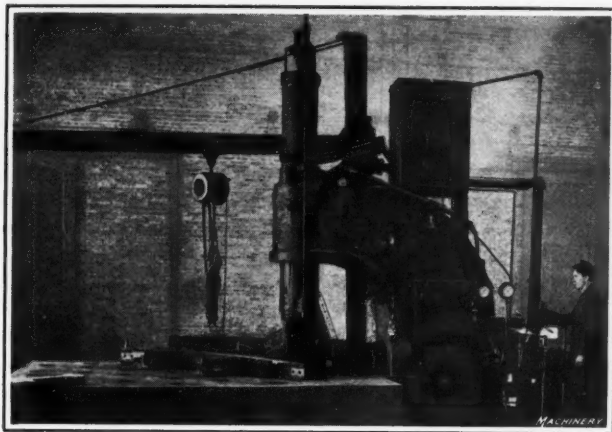


Fig. 75. There are many pieces of work that are a little difficult for one man to handle alone, and if he attempts to do so, he is likely to waste a considerable amount of time in setting up. This illustration shows the use of a jib crane equipped with a Yale & Towne chain block for handling such work



Fig. 76. Car axles are too heavy to be handled by one man. This illustration shows a view in the Griffin Wheel Co.'s plant in Chicago, where each axle lathe is equipped with an air cylinder hoist for setting up work and removing it. Turned axles are rolled on rails to the hydraulic wheel press

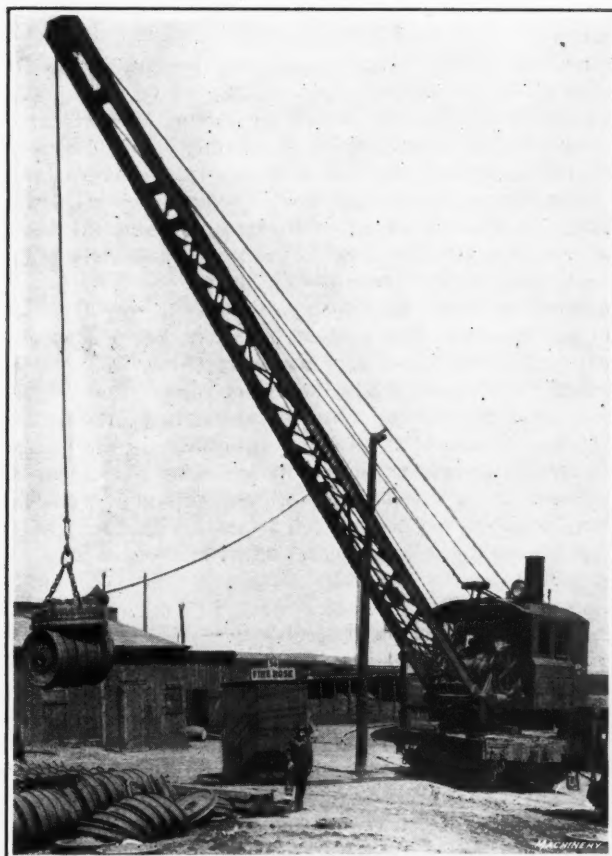


Fig. 77. A locomotive crane is useful for handling materials in factory yards where there is a lot of space to be covered. This equipment may be employed as a switch engine when there is no lifting to be done. The illustration shows a locomotive crane and lifting magnet used by the Griffin Wheel Co., Chicago, Ill., for handling car wheels

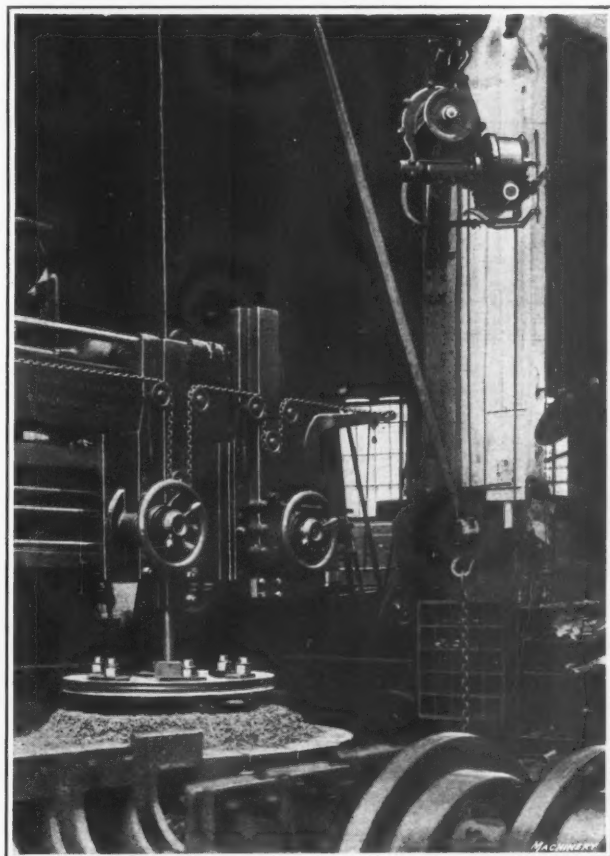


Fig. 78. An "Imperial" pneumatic motor hoist built by Ingersoll Rand Co., New York City, is used to assist the operator in setting up heavy work on a turret lathe and to remove completed work from machine. Having an individual hoist for a machine avoids loss of time by the operator and machine in waiting for assistance

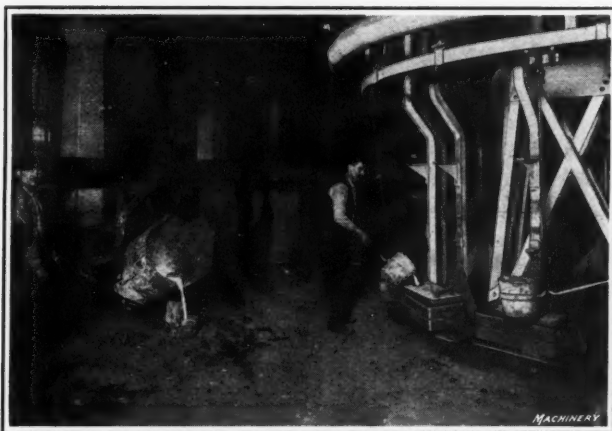


Fig. 79. To facilitate pouring metal into molds in the Ford Motor Co.'s foundry, molds are brought in on a conveyor and transferred to a carousel on which each mold is supported by a pendulum. This swinging support eliminates vibration and prevents molds breaking. Molds are carried away by a second conveyor



Fig. 80. One jib crane can often be arranged to serve a number of machines, molds, etc. In the Griffin Wheel Co.'s foundry, car wheel molds are arranged in a circle, with a jib crane at the center, equipped with an air hoist built by the Curtis Pneumatic Machinery Co., St. Louis, Mo.

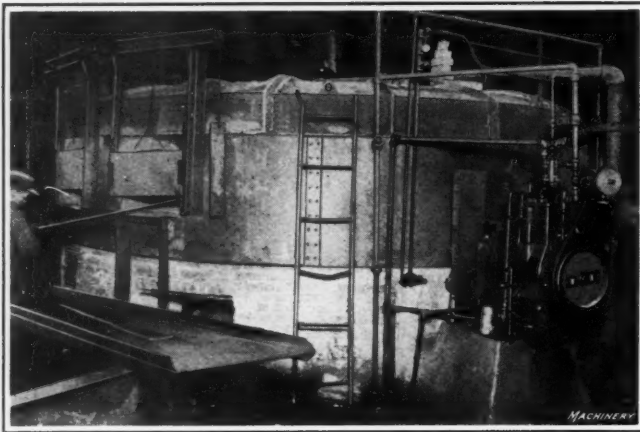


Fig. 81. In the Timken-Detroit Axle Co.'s plant special furnaces with a rotary hearth are maintained at such a temperature that forgings are raised to the proper temperature for heat-treatment by one revolution. These furnaces save space and keep operator busy

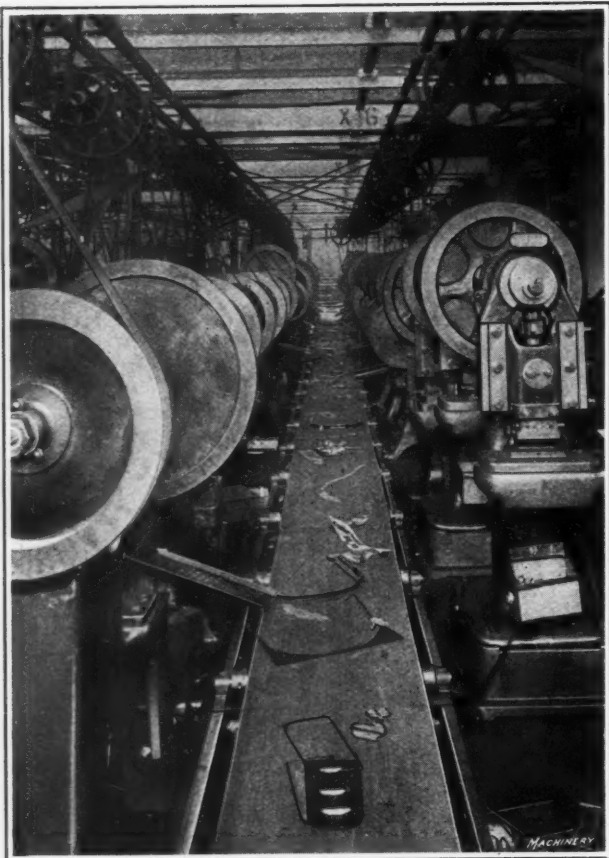


Fig. 82. In the Ford Motor Co.'s plant, use is made of belt conveyors for carrying away the product of power presses. Chutes are provided by means of which the product is transferred from the machines to the belt conveyor which carries it away. This is the means of saving the time ordinarily required for removing the product in trucks



Fig. 83. An elevator raises the work to the upper floor in the Willys-Overland Co.'s plant. This equipment, installed by the Link-Belt Co., Chicago, Ill., consists of an apron-type conveyor with cleats to prevent the work from slipping back. A chute at the left returns the tote boxes to the lower floor

rail at each side so that it is impossible for the load to run off. A simple method and one that is highly satisfactory where the packages or parts to be carried are of fairly regular shape, is to have a small flange at both ends of each roller. This flange rotates with the roller so that there is no loss of efficiency through the retarding action of a fixed guard rail, and still it is effective in preventing work from running off. A still simpler method and one that is effective in cases where the work has a smooth surface to run on is to make the conveyor with two sets of rollers. These rollers are arranged in pairs, with the rollers of each pair inclined at a slight angle, so that the two rollers have a form somewhat similar to the letter V (the angle is much less acute) with the apex pointing in the opposite direction to that in which the load is to travel. The effect of this inclined double roller construction is to keep the load on the conveyor, the tendency of each of the inclined rollers being to force the load toward the center. For handling pig iron and other irregular shaped pieces of this kind, the only way to be sure of keeping the load on the conveyor is to use a guard rail at each side.

Use of Revolver

A machine known as a "revolver" is built by the New York Revolving Portable Elevator Co., Jersey City, N. J. This is a portable elevator mounted on a revolving base so that the elevator platform may be faced in any direction to receive or discharge a load, as the case may be; ball bearings in the revolving base enable the elevator to be easily swiveled when carrying its maximum load. This type of equipment is used for a variety of different classes of service in industrial plants, but a typical case is where it is desired to raise or lower a load and turn the elevator in the direction in which the load is to be deposited. For instance, suppose that a stock-room is arranged with aisles running over to the wall and the necessity for economizing in the use of space makes it necessary to stack material up almost to the ceiling. Here the revolver may be used to excellent advantage, as the material is brought on elevating trucks or in any other convenient way and deposited on the platform of the revolver. The load is then raised to the desired height and the platform turned so that the load may be run off at either side of the aisle onto the top of the material already stacked.

A similar use is where sheet metal and other material is being stacked in racks; the revolver carries the load down an aisle, and when it reaches its destination, the platform is raised and turned through one-quarter revolution to allow the load to be slid off onto the racks. Another similar example is where heavy dies for use on power hammers and presses are kept in storage racks. These dies are so heavy that they are hard to handle, and work of this kind can be done conveniently by pulling them out on the platform of the portable elevator, which is then lowered to a convenient height. The entire elevator then serves as a truck on which the die is pulled to the machine on which it is to be used. Here the platform of the elevator is adjusted to bring it to the same height as the bed of the machine, so that the die may be easily slid off the elevator platform, into place on the machine.

Portable elevators of this type are made in two standard sizes, with capacities for handling loads up to 800 pounds and 1800 pounds, respectively. By the use of special bracing, elevators have been made for carrying loads up to 2500 pounds. Elevators up to and including seven feet in height are made with the structure in a single piece; but when the height exceeds seven feet, the structure is hinged so that no difficulty is experienced in pulling the elevator through doors from one department to another. The platform is raised by hand by means of gearing turned by a crank. When it is necessary to lower the load, the first step is to take the crank off the squared end of the shaft; the crank is then fitted onto a lowering brake, and until this is done the platform cannot be lowered. By means of the crank, the brake may be adjusted to any required degree while lowering the load.

In revolving the entire structure of the elevator, the first step is to withdraw a locking pin that holds the elevator in one of four 90-degree positions around the complete circle.

When this pin has been withdrawn, the elevator is usually turned by hand, taking hold of the elevating crank. Some users of portable elevators employ them as a means of transporting material from one department to another located on a higher or lower floor. This is done by having a trap door in the upper floor through which the elevator platform may be raised or lowered with the material. Such an arrangement would only be recommended where departments are not laid out in the normal way; ordinarily, where there is a demand for equipment to transfer work from one floor to another, some permanent form of elevator would be more desirable.

Portable Scoop Conveyor

For handling coal of all grades, coke, ashes, crushed stone, sand, gravel, small castings and a variety of other similar material, the Portable Machinery Co., Inc., Passaic, N. J., is now building the portable scoop conveyor shown in Fig. 87. This equipment consists of a scoop which can be buried in the material to be handled, and an endless traveling belt which carries the material up and discharges it into a wagon, chute or other receiver. The conveyor belt has transverse cleats to prevent the material from slipping back down the incline. One man and this scoop conveyor can handle coal or similar material at the rate of one ton in one and one-half minute, i. e., forty tons per hour. This outfit can be equipped with an electric motor or gasoline engine for driving the belt, and as it weighs only 900 pounds and is mounted on wheels, it may be easily taken to any desired place. The amount of power required to drive the conveyor is $1\frac{1}{2}$ horsepower.

A special machine is used at the plant of the Boss Nut Co., Chicago, Ill., to charge tumbling barrels with blank punched nuts, take these nuts from the tumbling barrels, and distribute them in bins located convenient to the tapping machines. This apparatus consists of a modified form of the standard tiering machine built by the Economy Engineering Co., Chicago, Ill. It has a cantilever type of platform, open on three sides. The main uprights extend into a pit about three and a half feet below the floor level.

The platform consists of two arms, on which run the flanged wheels of a small transfer car; the latter, in turn, carries a pair of rails at right angles to its direction of movement. On these rails is placed a small hopper-bottomed car with a capacity of about 2000 pounds of punched nuts. The pit extends under the tumbler, and at the bottom are rails to allow the transfer car with the hopper car to be moved to a position directly under the tumbler. A steel frame is also provided above the tumbler so that the transfer car can be moved over the tumbling barrel. At one side of the machine is a row of bins, over the tops of which runs a track on which the hopper car moves.

To charge the tumbler, the platform of the machine, with the transfer and hopper car, is lowered to the bottom of the pit, bringing the top of the hopper car on a level with the floor. The punched nuts are then dumped into it from the kegs in which they have been deposited at the punchers. The platform with its load is then raised to the top position and the transfer car with the loaded hopper car moved to a position over the tumbling barrel, where the gates at the bottom of the hopper are opened and the nuts drop into the tumbling barrel. Here they are tumbled with sawdust until polished. The tumbling barrel is provided with perforations and a wooden tray is placed under it while the tumbling operation is being carried on, so that the sawdust gradually works out and is entirely eliminated by the time the polishing is completed. To empty the tumbling barrel, the transfer car is again moved into the elevator platform and lowered to the position in the bottom of the pit, where it is moved under the tumbler and the polished nuts are deposited in the hopper car. It is then returned to the elevator and hoisted to the level of the track over the bins and then pushed by hand to the proper bin, where the load is deposited by opening the gates in the bottom of the hopper.

The elevator is operated by means of a three-horsepower General Electric motor, through silent chain drive to a series of machine-cut spur gears connected to a drum upon which the steel hoisting cable winds. Automatic top and bottom



Fig. 84. A jib crane must be provided with support for the outboard end of the beam. This is often done by means of tie-rods. In this case the ceiling is too low to permit of this construction, so the outboard end of the beam is furnished with a trolley which runs on a semi-circular rail.



Fig. 85. In automobile tire factories there are a lot of heavy molds to be handled, and some means of assisting the operators must be provided. This view shows a chain hoist built by the Wright Mfg. Co., Lisbon, Ohio, in use in the Knight Tire & Rubber Co.'s plant. The molds are being placed in a vulcanizer.



Fig. 86. Combinations of equipment are often necessary. This view in the Detroit Wire Spring Co.'s shops shows a conveyor and elevator. Assembled cushion springs are carried to the crating department, where they are packed, and the elevator carries crates to shipping department.

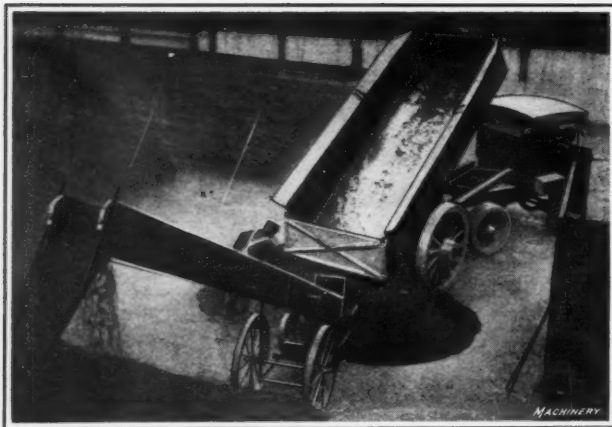


Fig. 87. For handling loose material, such as coal, sand, etc., a scoop conveyor is made by the Portable Machinery Co., Inc., Passaic, N. J. This consists of a scoop and a power-driven belt conveyor that carries the material up an incline and delivers it into a chute

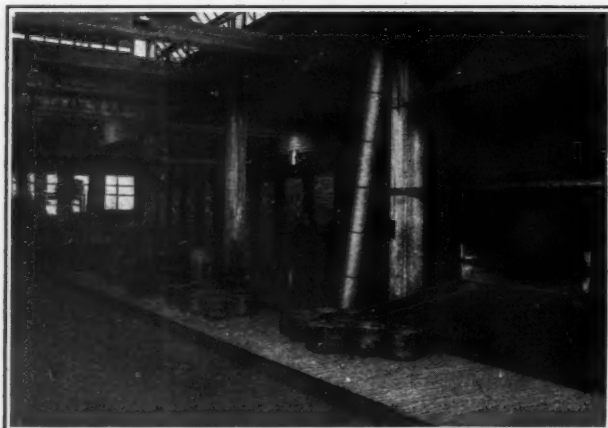


Fig. 88. There is often lack of system in handling metal goods which are to be heat-treated; this results in an unusually heavy charge against the work. The Chain Belt Co. of Milwaukee, Wis., has installed a special apron-type conveyor with chutes for carrying heavy drawn steel shells

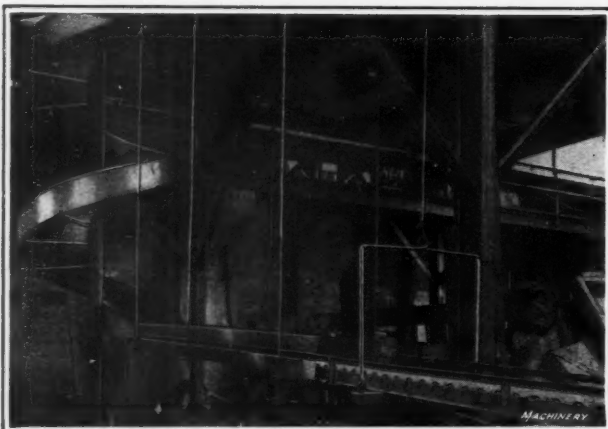


Fig. 89. For unloading flywheel castings from freight cars, the Cadillac Motor Car Co. of Detroit, Mich., has a spiral steel chute leading down from the platform on which the load is discharged. The castings are ejected from the chute onto a gravity carrier

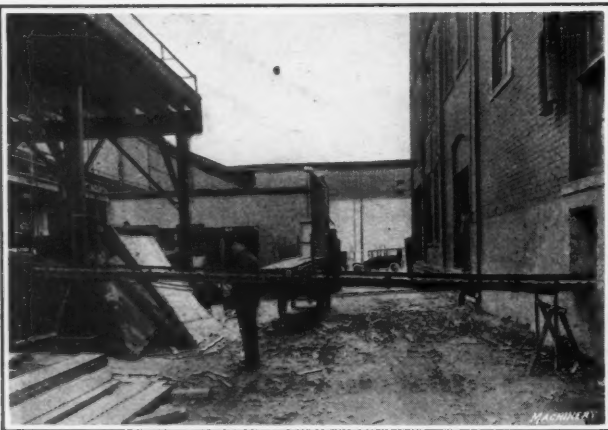


Fig. 90. This illustration shows the gravity carrier leading from the spiral chute shown in Fig. 89 to the machining shop. The carrier is suspended on cables so that it may be raised to provide the necessary head room for a team to go underneath

stops and other safety features are provided, making the machine largely automatic in its action, one ordinary laborer being all the help required.

Bringing the Saw to the Shafting

The Mechanical Appliance Co., Milwaukee, Wis., has developed a novel method of handling the steel shafting that it uses in the manufacture of its product. Shafting of from $\frac{1}{2}$ to $3\frac{1}{2}$ inches in diameter is used. It was found that a great amount of time and labor was consumed in bringing heavy shafting to the hacksaw from the racks onto which the shafting was loaded from the trucks. Instead of bringing the heavy shafting to the hacksaw, the motor-driven hacksaw is brought to the pile of shafting. The shafting is stacked onto the racks from the trucks. The hacksaw is raised to the correct level of the shafting by means of a tiering machine built by the Economy Engineering Co. One operator is able by means of this arrangement to take care of the complete operation of cutting off shafting from $\frac{1}{2}$ to $3\frac{1}{2}$ inches in diameter. As many as six men were formerly employed to carry the long pieces of the heavier sizes of shafting to the saw.

Adapting Transportation Methods to Requirements of Shop

In working out methods of progressive assembly for use in his factory, a manufacturer must bear in mind the volume of work which is to be handled. It would not pay to install a complex equipment of conveyors, trolley systems, etc., to facilitate handling work unless the volume of product was sufficient to keep equipment of this kind employed so that a reasonable return would be earned on the investment. Even in highly organized shops handling a moderate volume of product each day, little attempt is made to employ a complete outfit of mechanical contrivances for handling the work, because it is realized that there would be little likelihood of obtaining a satisfactory return on the investment. Recently we have seen some exceptions to this rule that are probably due to the condition of the labor market. Unskilled labor has been so scarce and has commanded such exceptionally high prices that some manufacturers have substituted mechanical means of handling as far as possible. This has been particularly true in shops engaged in certain munitions work where the necessity for making deliveries at an early date has demanded the employment of every possible means to increase production rates.

Plants handling an extremely large volume of product are best suited for the installation of complete systems of conveyors, trolleys, gravity carriers, chutes and other forms of equipment arranged in combination, so that as soon as one workman or group of men have completed their task on a given piece of work it may be placed on a mechanical carrier that will convey it to the department where the next operation is to be performed. Aside from the reduced cost of production made possible through the reduction in help, the employment of mechanical carriers has another important feature which commends it to the attention of manufacturers operating large factories in which there is likely to be a congestion of machines and product. Unless mechanical carriers are used, the alternative is to make transfers on trucks pushed by hand or by power, and the handling of a large amount of work in this way is bound to create confusion—especially when aisles are blocked or there is other interference with the movement of the trucks.

In an article of this kind it is the aim to explain fundamental principles and describe methods which the average manufacturer can employ in his own shop. On this account, the methods of handling material and product in extremely large plants are not entered into in detail, inasmuch as they require complete installations of mechanical transporting facilities and an engineering staff capable of laying out all kinds of equipment. Nevertheless, all manufacturers will be interested in reading of the equipment employed in the factory of the Willys-Overland Co., Toledo, Ohio, for the final work of assembling parts of automobiles.

General Arrangement of Equipment

The department in which the final assembly is conducted is laid out with four tracks, down which the automobiles are

pulled by chain conveyors that were installed by the Link-Belt Co., Chicago, Ill. The automobile frame is placed on this track and a hook on the chain conveyor takes hold of the front axle to draw the frame along. Features of the progressive method of assembly have been explained previously, so they need not be considered here. The point of greatest interest is the arrangement of the auxiliary carrying systems that bring parts to the main assembling track at the different points where the parts are to be assembled onto the car. There are four of these tracks that run lengthwise down the shop, and a large number of conveyors running crosswise. Each of these cross conveyors brings such parts as lamps, mud guards, radiators, etc., to the four main assembling tracks at those points where the different parts are to be added to the car; and all the time that this continual stream of parts is running across the shop, the automobiles in course of assembly are running lengthwise, so that as each car passes down one of the assembling tracks the different parts which go to make a complete car are brought over to the assembling track and secured in place. This system has been carried to such a degree that when the gasoline tank is delivered to the assembling track by one of the cross conveyors, it contains sufficient gasoline to allow the completed automobile to run out of the assembling department on its own power.

In the various manufacturing departments, as well as in the assembling department, use is made of conveyor systems for handling work in course of manufacture and finished parts. For the parts of a product as complex as a modern automobile, it will be evident that a great variety of carrier systems must be provided, and in the Willys-Overland plant use is made of practically all the standard conveyors, trolleys, etc. For instance, completely assembled motors are handled on apron-type conveyors or on trolley systems, from which they are suspended in a suitable sling. Advantage is taken of the circular form of wheels and tires, and they are rolled down gravity carriers. Gravity is also employed for carrying certain forms of castings and similar parts, but it is necessary to provide some form of roller conveyor, because the castings could not be rolled. In the case of lamps, mud guards and many other parts of a like nature, there is no better method of carrying than on a trolley system, and extensive use is made of this form of equipment. In addition to standard conveyors, many special forms of equipment have been provided for handling parts of unusual form, and a general idea of the diversity of the carriers that have been installed by the Willys-Overland Co. will be gathered from the illustrations presented in this and the preceding installment, showing views in this company's plant. These are by no means complete, but they serve to give an idea of the great variety of methods of handling that have been adopted to meet different conditions and the care that has been taken by this company's engineering department in studying all the available methods and adopting those that have the greatest number of features to commend them.

Development of Special Forms of Carriers

In working out the transportation system for any factory, the engineer in charge of the work has at his disposal numerous forms of standard equipment that are manufactured by plants making a specialty of this work, and it is desirable, whenever possible, to adopt the use of standard forms of equipment, because a plant specializing in such work can usually furnish equipment at a price considerably lower than that at which special equipment could be made for a given service. There are many cases, however, where the nature of the work to be handled is such that it demands the use of special equipment, and under those circumstances the engineer who is laying out the transportation system would be called upon to design suitable equipment for the work. This may involve the development of special methods of handling, but in many cases it will be found possible to use standard equipment and add special features to adapt it for a given service.

Where it is found that standard equipment cannot be obtained for handling the work, the next step of the engineer should be to ascertain whether certain standard forms of equip-

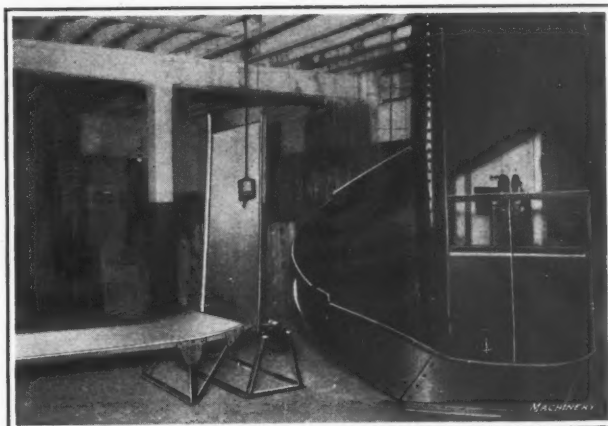


Fig. 91. Where spiral chutes are employed to carry work through a building, it is often desirable to discharge the load on some of the floors through which the chute passes. The chute shown (Mathews Gravity Carrier Co., Elwood City, Pa.) has a branch for this purpose

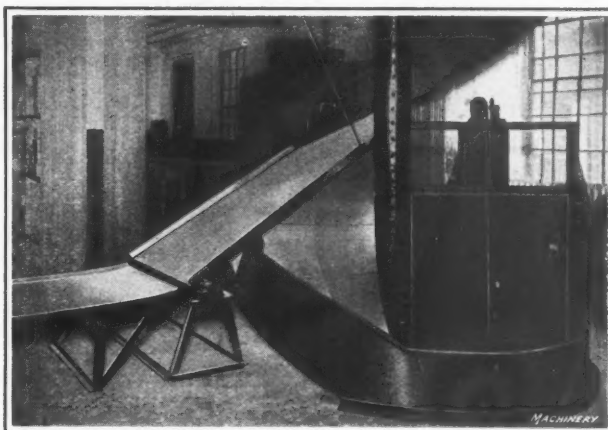


Fig. 92. This illustration shows the same equipment shown in Fig. 91, but here connection is made with the branch chute. Attention is called to the fire door; this is held open by a fusible link, which will melt and allow the door to close automatically in case of fire

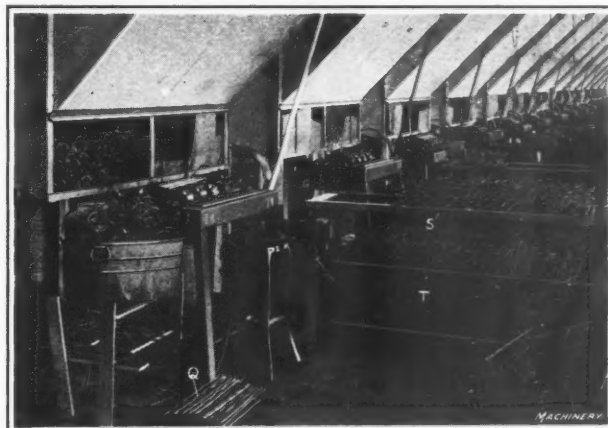


Fig. 93. In the Detroit Wire Spring Co.'s shops extensive use is made of chutes for carrying work from upper to lower floors. Here we see chutes down which coiled springs are delivered to the department in which these springs are assembled into strips

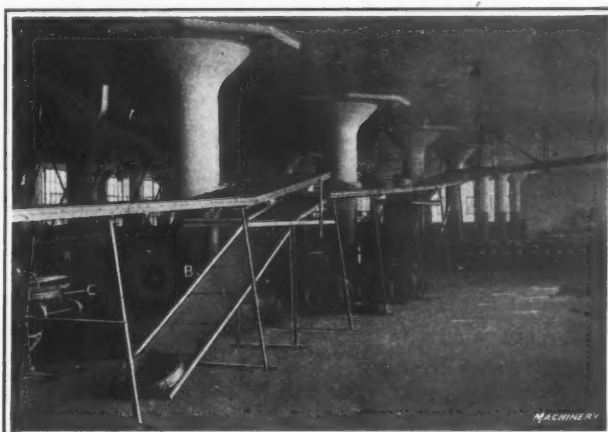


Fig. 94. Where gravity carriers are used it is desirable to provide for discharging the load at different points in the shop. In the illustration provision is made for raising sections of the carrier at different points, so that the load may run under the rollers and slide down the chute

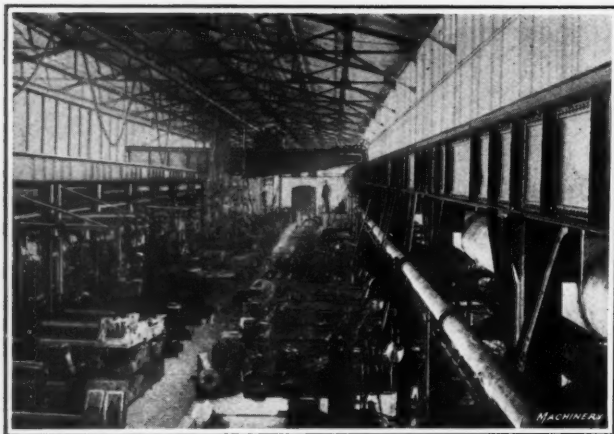


Fig. 95. In some machine shops compressed air is preferred to electric power. Such a case is shown in this illustration. Attention is called to the way in which the hose connection to the pneumatic motors is hung in festoons so that there will be plenty of length to enable the crane to run to the far end of the building

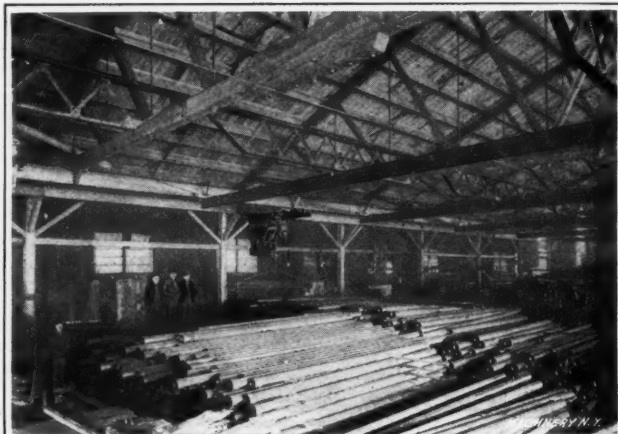


Fig. 96. When a number of trolley hoists are used on rails running parallel to each other, it is desirable to provide means of transferring trolleys from one rail to another. This can be done with a transfer bridge carrying a section of rail that may be lined up with some one of the main rails. The hoist is run onto the rail on the transfer bridge

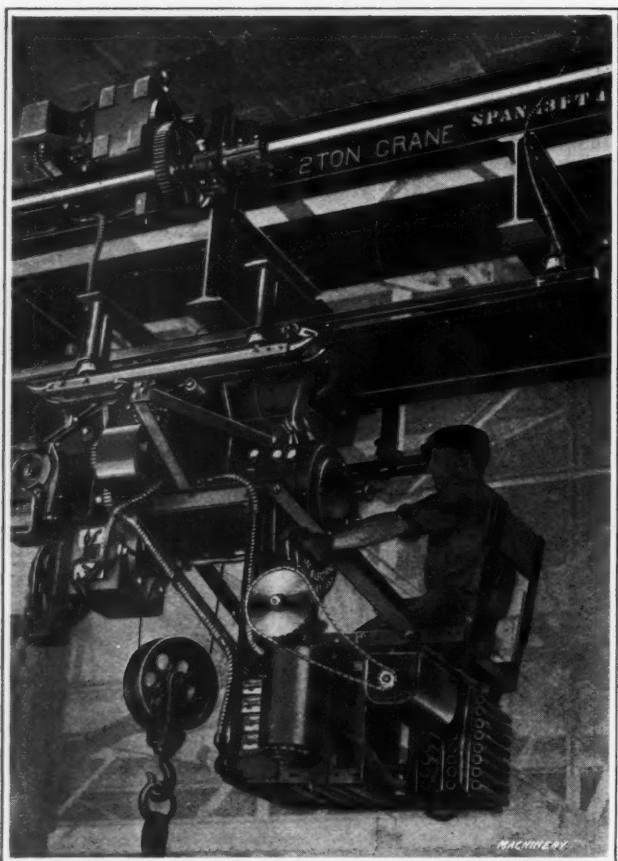


Fig. 97. This illustration shows a close view of the trolley in place on the rail of one of these transfer bridges. The trolley is locked while the bridge is in motion so that it cannot run off the rail. This equipment was built by the Sprague Electric Works, New York City

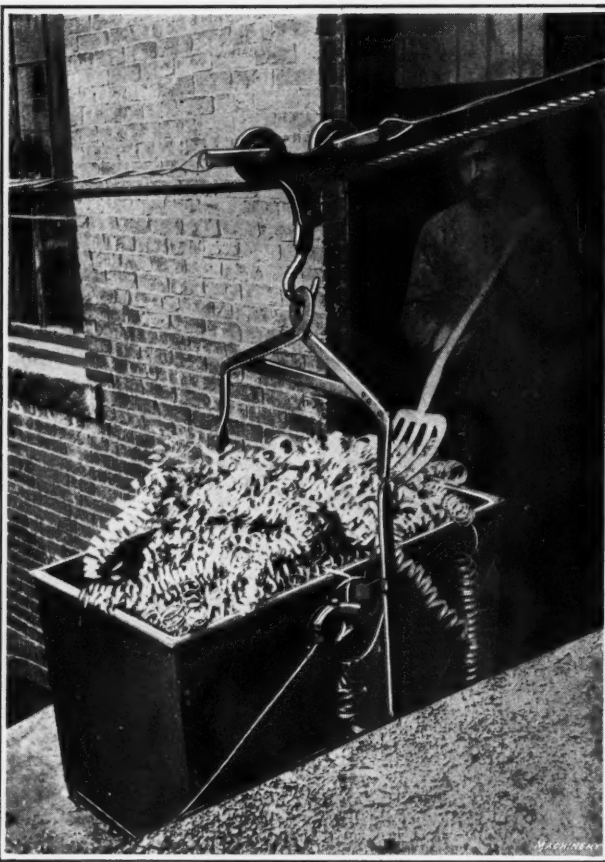


Fig. 98. In machine shops that produce large quantities of chips means must be provided for hauling these chips away to the scrap pile. The illustration shows a skip loaded with chips, which is pulled over to the scrap pile by a laborer, who removes the contents with a pitchfork

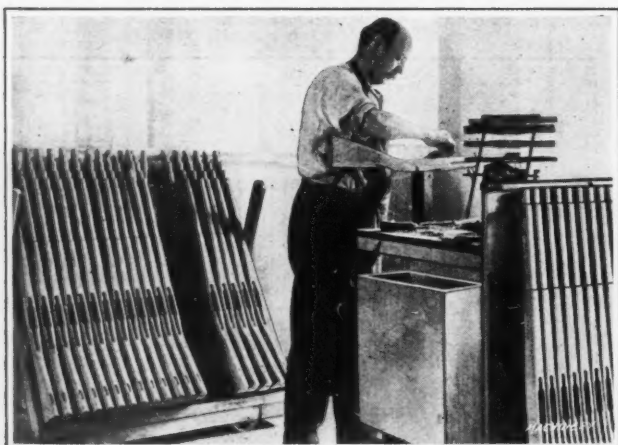


Fig. 99. In manufacturing military rifle stocks, each stock must be finished so as to present a good appearance. In the United States arsenals special trucks are used to carry the finished rifle stocks to prevent marring finished surfaces



Fig. 100. Durability is one of the most important features of any form of factory equipment. The Timken-Detroit Axle Co. makes steel boxes for use in connection with elevating trucks for carrying heavy metal parts, which are practically indestructible

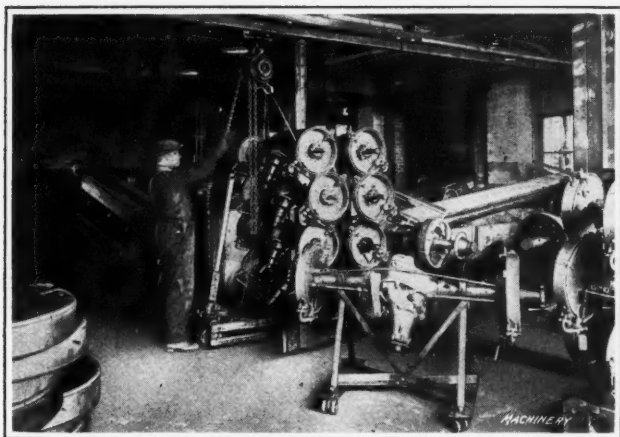


Fig. 101. In the Timken-Detroit Axle Co.'s factory axles are delivered to local factories on special motor trucks. A trolley hoist lifts an axle off the small truck onto a stand; when eight axles have been put on the stand it is picked up on an elevating truck and carried to the motor truck

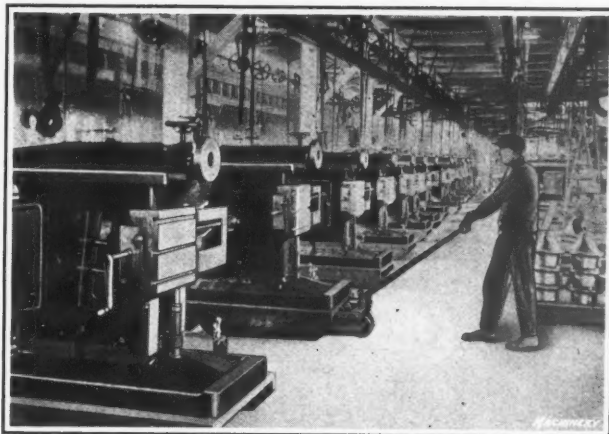


Fig. 102. This illustration shows how elevating trucks built by the Stuebing Truck Co., Cincinnati, Ohio, are used for handling the product of the Cincinnati Shaper Co. Machines are placed on skids so that they may be handled in the minimum time. The elevating truck enables the machines to be easily picked up and taken to exactly the desired spot

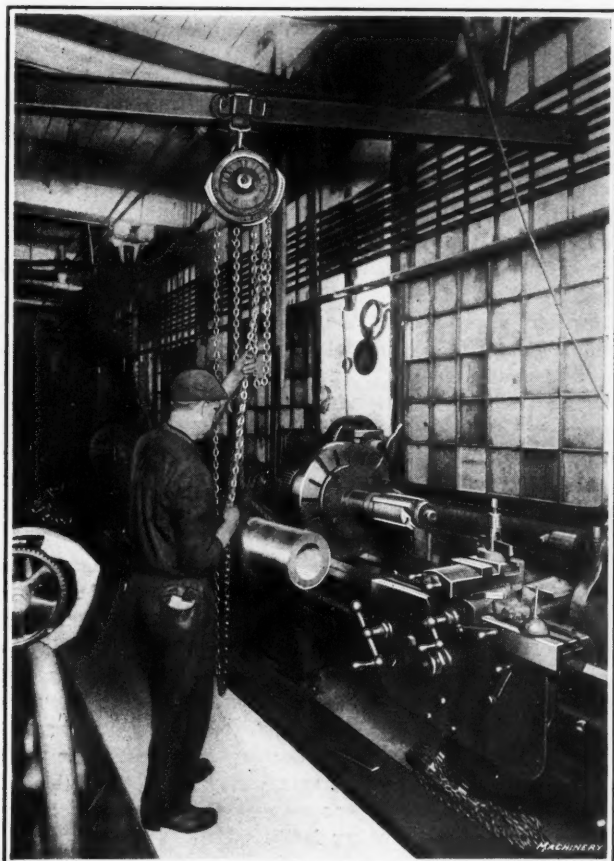


Fig. 103. In setting up heavy work on machine tools, it is desirable to use a trolley hoist in connection with each machine to conserve the operator's time. This illustration shows a chain hoist built by the Ford Chain Block & Mfg. Co., Philadelphia, Pa.

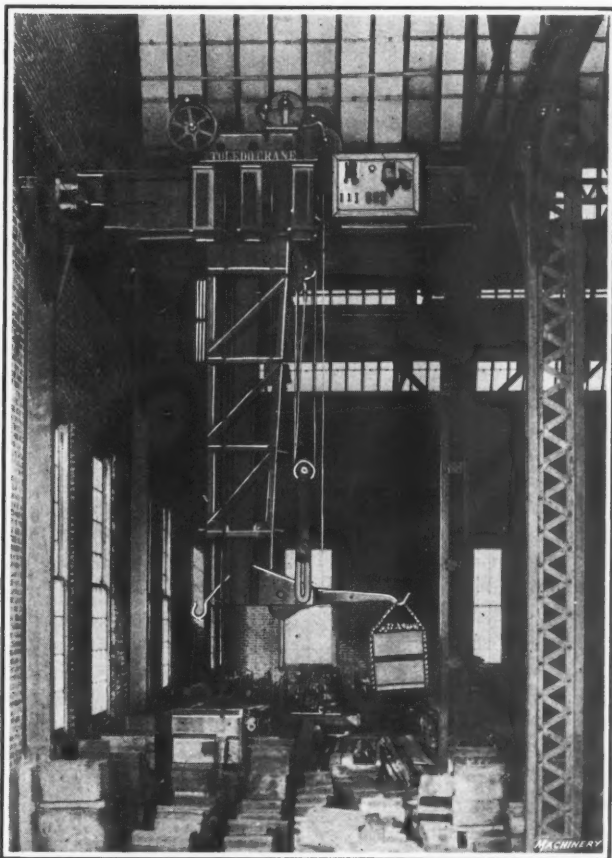


Fig. 104. The crane built by the Toledo Bridge & Crane Co., Toledo, Ohio, is used for placing dies on hammers or presses and transferring them to and from the storage department. The arm that carries the lifting hook is raised and lowered by means of cables



Fig. 105. For handling lumber, the Covell Mfg. Co., Benton Harbor, Mich., manufactures what is known as the "Ross" lumber truck. A load is built up to the desired size, after which the truck is driven over it and the load picked up. It is claimed that the cost of handling is six cents per 1000 board feet

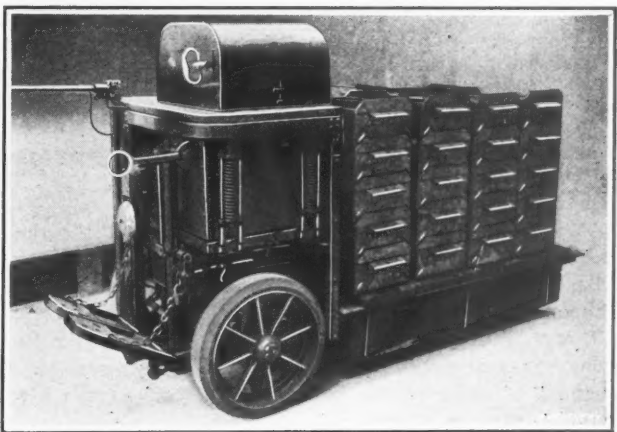


Fig. 106. This illustration shows how steel balls are handled in the New Departure Mfg. Co.'s plant in Bristol, Conn. Balls are placed in steel tote boxes made by the New Britain Machine Co., New Britain, Conn., and stacked up on the platform of an elevating truck built by the Elwell-Parker Electric Co., Cleveland, Ohio

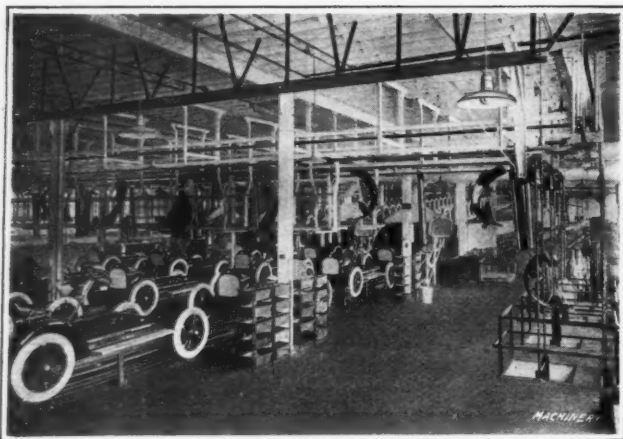


Fig. 107. In handling the progressive assembly of automobiles, the Willys-Overland Co. has tracks down which the cars are run during the process of assembly. Overhead trolley systems running at right angles to the line of travel of assembling tracks carry various parts to the assemblers



Fig. 108. Reference has already been made to the desirability of using combinations of equipment for handling material and produce which is being passed through a factory. This illustration shows the combination of an elevator, a gravity carrier and an apron-type conveyor for raising work from the lower floor and transferring it through the shop

ment furnished with special attachments for holding work, etc., cannot be made to meet his requirements. If so, it will be more desirable to use such equipment than to attempt to produce a complete special outfit. For instance, the Detroit Wire Spring Co., Detroit, Mich., recently laid out a complete new plant for the manufacture of automobile cushion springs. It was a point of great importance to provide methods that would enable the large volume of work constantly going through the shops to be passed along with the greatest possible dispatch. Certain features of this company's equipment are illustrated in this article, and it will be seen that mechanical carriers are employed for dipping work into japanning tanks, carrying the work into baking ovens, and many other purposes where manual labor would ordinarily be employed.

A bundle of coiled wire springs does not weigh very much, but it is of necessity quite bulky and calls for some special method of handling. The Detroit Wire Spring Co.'s transportation equipment consists largely of trolley systems, and to provide for carrying wire springs on trolleys it was necessary to develop special forms of carriers which could be used in conjunction with standard trolleys. This was worked out by arranging baskets for handling bundles of coiled springs and long racks on which a number of assembled cushion springs could be suspended. The adoption of this method enabled the engineering department of the Detroit Wire Spring Co. to buy standard hoists, trolleys and rails from manufacturers of this type of equipment, and then merely make its own racks, so that there was little special work to be done in getting everything ready for use. Needless to say, this was a less expensive installation than would have been a special outfit built for a particular class of service.

* * *

AFTER THE WAR—WHAT OF MACHINERY EXPORT?¹

Opinions regarding the export of machinery after the war range from extreme pessimism to broadest optimism. England and Germany have been the most potent competitors of America in the machinery market, but Germany is arrayed against us, and it is reasonable to premise that the nations now at war will later cooperate with their present allies along economic lines. Further, for a considerable period at least, the products of Germany will find little favor among the Allies, with the possible exception of Russia. It would thus appear that for some time we may reasonably anticipate having only England as a serious competitor. Later, Canada may become an important factor in the machine-tool industry.

Although the present great demands on the resources of Europe have encouraged in England the highest possible development of those classes of machinery that have a direct bearing on the war, there has probably not been a similar development of automatic and other types of machines that until a few years ago were peculiarly American. Therefore,

¹Abstract of a paper read at the Export Conference, Springfield, Mass., June, 1917, by C. O. Smith, sales manager, Norton Grinding Co., Worcester, Mass.

in many of these lines we may expect to occupy a commanding position in the industry.

Another factor that will loom large in our machine-tool industry is the labor question. While there may be no reduction in wages in this country for a number of years, because of the labor shortage, etc., wages abroad will so increase as to materially aid our export business. Further, the return of those soldiers, from the less enlightened sections, who have been prisoners in Germany will create among their people desires for the better things of life, and they will be satisfied with nothing short of an approximate fulfillment of these desires. However, regardless of the apparently favorable competitive conditions and the essential needs for the work of restoration, as well as the meeting of normal demands, our prosperity following the war will be largely dependent on the restoration program. Will our allies inaugurate a "pay-as-you-go" policy, which contemplates reconstruction through their own resources, or will they avail themselves of America's credit so that the devastated districts may utilize to its fullest capacity the labor of their remaining populations?

Indications are not lacking that Europe contemplates an eventual industrial development far beyond that attained prior to the war, thereby utilizing a large proportion of that great army of metal workers that during the present crisis is supporting the armies at the front. Heavy purchases of machinery are being made, largely for use after the war. Besides, many difficulties have developed during the war which seriously interfere with satisfactory financial arrangements; this has been most evident as affecting sales to Russia. Also for some time after the war we may expect to be handicapped through a lack of shipping facilities.

Assuming that the views here expressed as to the immediate future in Europe are far too optimistic, are there other fields wherein we may develop an outlet for our surplus product? Canada has but recently experienced the prosperity that comes from intensive industrial effort; nothing short of continued development along these lines will satisfy these "Yankees of the North." South America, which has purchased German goods so heavily, is now looking to us for supplies. India, South Africa and Australia will favor England whenever possible, but China, although regarded by Japan, from a commercial standpoint at least, as her rightful heritage, strongly favors American things in her industrial upbuilding.

One factor that will decrease industrial unrest and materially improve our export business is the establishment of fair standards of production and wages. If this problem is correctly solved, one of the greatest handicaps to an aggressive seeking of world trade will be removed. There is also a feeling on the part of the foreign buyer that when our business is good at home, scant attention is given business abroad; as soon as business is less prosperous, there is a rush to dispose of our products in the foreign market. If the foreign buyer of machinery is given value received in the goods purchased and the attention necessary to produce the results to which he is entitled, he will be loyal to his source of supply.

GAGES FOR TIME-FUSE PARTS¹

PROBLEMS IN THE MANUFACTURE OF GAGES FOR RUSSIAN TIME FUSES AND METHODS BY WHICH THEY WERE SOLVED

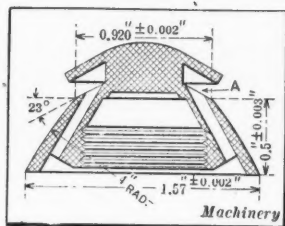
BY DONALD A. BAKER²

Fig. 1. Cap of Russian Time Fuse

MANY of the gages and jigs used in the manufacture of Russian time fuses present unusual problems to the toolmaker. In order that the use of the gages and jigs may be clearly understood, the parts of the fuses are illustrated; Fig. 1 shows the cap, Fig. 2, the top ring of the fuse, and Fig. 3, the body. In Fig. 4 is shown a gage for testing the relation of the various holes in the top ring. As a number of these gages are required by the inspectors, and as they wear rapidly, a master gage, Fig. 5, is used for testing them and keeping them standardized. This consists of a piece of annealed tool steel, bored out to fit over the center plug of the working gages and having the necessary holes properly located for testing the gages. The special tools and fixtures required for making the master gage were so designed that they could be used in the manufacture of the working gages. The master gage is made as follows: After a piece of steel is roughed out and a 5/16-inch hole reamed in its center, it is placed on a mandrel and turned and faced to the proper size, enough material being left on the faces to grind them perfectly parallel. After grinding, hole A is bored, the work being strapped to an angle-plate, swung on the bench lathe faceplate. The angle-plate is located the proper distance below the center by plug A, Fig. 6. One end of the plug passes through the hole in the faceplate, and is held in a spring chuck, while the other end is turned to the proper diameter for locating the angle-plate when the plate is brought against it, as shown.

The work is then located approximately on the angle-plate, and the lathe spindle is turned until the face of the plate, with the work attached, is at right angles with the top of the lathe bed; this is tested by placing a parallel across the ways of the lathe and using a square from the surface of the parallel. An indicator attached to a surface gage is then used to set the work central, being brought first against one edge and then against the other, the lathe faceplate being turned a half revolution for this purpose. After the work is securely strapped, it is tested to see that its position was not changed when tightening the clamps. The work is then center-drilled with a combination drill and counterbore. It is drilled a little smaller than the desired size, and a small boring tool is used to enlarge and true up the hole sufficiently to start a reamer; the starting hole must be of the proper size for the reamer to fit into it. This operation of boring and reaming is repeated several times; for instance, 0.002 inch may be removed with the first reamer, about 0.001 inch with the second, and 0.0005 inch with the third—the last being more of a burnishing than a cutting operation. The finishing reamer should leave between 0.0002 and 0.0005 inch to be removed with a solid lap. The lap is made of either brass or copper, preferably the latter, charged with washed flour of emery. It is held in the fingers and the work revolved against it.

Boring Angular Hole in Master Gage

For the next operation, boring the angular hole B and the two half holes C and D, Fig. 5, a special angle-plate is used on the bench lathe faceplate. This consists of a flat plate A,

¹For other articles on making fuses, see "Manufacturing Parts of Type 80 Time Fuses," in the December, 1916, number of MACHINERY, and other articles there referred to.

²Address: Williams Mfg. Co., Ltd., Montreal, Canada.

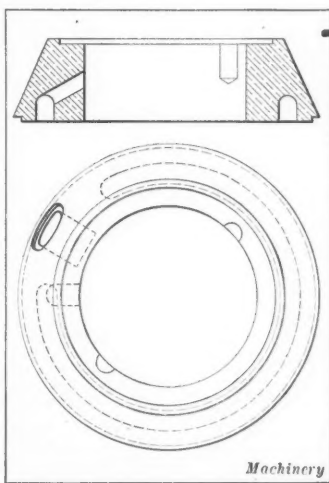


Fig. 2. Top Ring of Russian Time Fuse

Fig. 7, which is ground perfectly parallel, and a plate B, shaped up and ground accurately on the faces and edges, and having accurate angles. An accurate angle-plate and sine bar are used to make the angles correct. The master gage is placed over a plug inserted in a 5/16-inch hole C bored and reamed near the center of this plate. The plate also contains two holes D and E for locating and boring the two half holes in the master gage; while this is being done, plate B is used separately from plate A. These two holes are carefully located by the following method: First a hardened, ground and lapped plug A, Fig. 8, is made. One end of this plug fits the center hole in plate B and the other end is 1/2 inch in diameter; near the middle is a disk-like section. The diameter C of the disk is such that when two 1/2-inch standard jig buttons are placed directly opposite, one on each side of the center plug and against its edge, as shown, their center distances will be equal to the center distance of the two holes to be bored.

The position of the buttons having been laid out roughly and the holes for the button screws having been drilled and tapped, the buttons are put in place and held lightly by their screws. The plate is then placed on its edge, as shown, and the sine of the angle having been found by calculation, the tool D is used to set one of the buttons in position. This tool consists of a tool steel base A, Fig. 9, which is hardened, ground and lapped on the bottom, and several lengths of drill rod, the ends of which have been hardened, rounded off and lapped smooth. These rods are held in the body and can be clamped securely in place by screw C, the body being split at B. The rods are first set to the proper distance from the base of the tool by the aid of a micrometer, one rod being set to the distance from the bottom of the plate to the edge of a button, and the other to the distance from the side of the plate to the edge of a button. The rods are adjusted by lightly tapping them, as when setting an ordinary firm-joint caliper. Sometimes the rods are threaded, when they are adjusted by screwing in or out. To locate the buttons, the plate is set first on one edge, then on the other, using the tool as a feeler by sliding it along the surface plate underneath the button, and tapping the button in the direction that the feeler shows it should go, until the "feel" is just right. This method applies to the setting of any button, but as in this case one dimension is supplied by the central plug, only one dimension is needed—that from the bottom of the plate to the edge of the button.

The second button on the plate can be adjusted by using a knife-edge straightedge to get the two buttons and the plug dead in line. The straightedge is tried first on one side and then on the other, and the screw of the second button is tightened, when finally adjusted, so that the straightedge no longer "rocks." After the buttons are set in the proper position, the plate is strapped lightly to the lathe faceplate and one of the buttons indicated until it runs true. Then the straps are tightened and the button again indicated to make sure the clamping has not disturbed the setting; if it still runs true, the button is removed and the hole bored, reamed

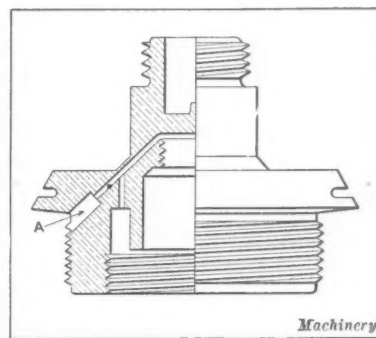


Fig. 3. Body of Russian Time Fuse

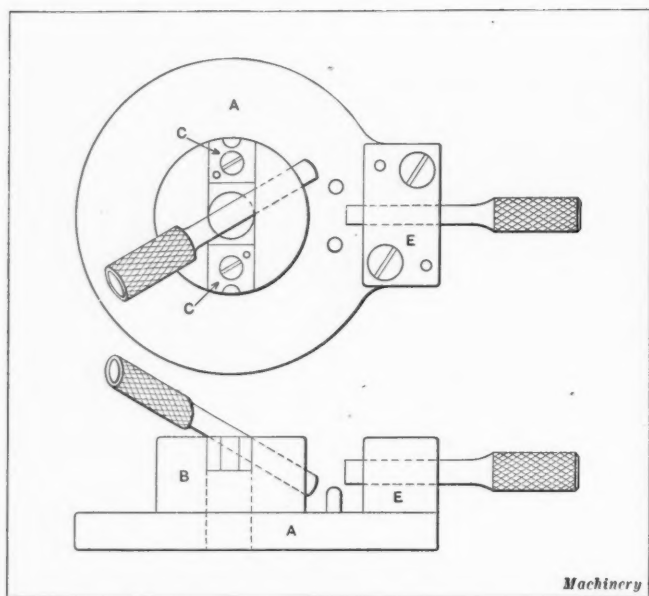


Fig. 4. Gage for testing Holes in Top Ring

and lapped as described for the master gage. After the first hole is finished, the second is treated in a like manner and the plate completed.

To use this master plate, a plug is placed in the center hole and the master gage is placed over this, being held in position by putting a few drops of solder around the edge. Next a special collet with a hole bored through it is placed in the lathe, as shown in Fig. 10. In the end of the collet is placed a piece of 5/16-inch hardened drill rod A, the end of which is ground and lapped to fit the holes in the master plate. After this collet is in place and the end of the plug is ground, the faceplate is put on and indicated on its face, to make sure that it runs true; then the master plate, carrying the master gage, is located by putting it over the center plug in the lathe, and strapped fast in the proper position for one of the two half

holes to be bored.

The remainder of the operation is the same as described for the other holes. The second half hole is treated in the same manner.

The method of boring the angular hole B, Fig. 5, is one seldom used. Although the locating of this hole is usually considered one of the things that must be found by the most unsatisfactory cut-and-try methods, it may

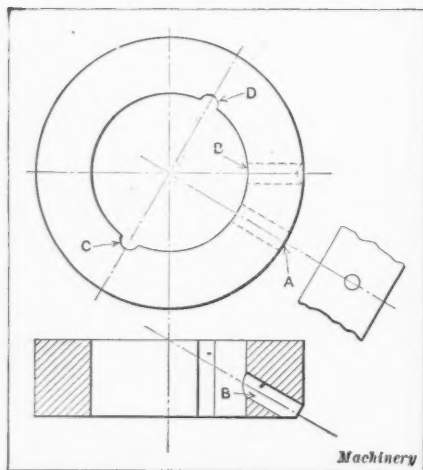


Fig. 5. Master Gage for testing Gage shown in Fig. 4

be accurately done as follows: The two plates A and B are screwed and doweled together, as shown in Fig. 7, converting them into a special boring fixture, or master angle-plate. Then a special plug having a hardened steel ball F at one end is made up. Commercial steel balls are used, as they are readily obtainable and are usually accurate as to sphericity. This plug is placed in the 5/16-inch hole in the plate and the ball is adjusted with micrometers until its center is as far from the face of the plate as the sine of the angle of the hole to be bored. The boring fixture is then strapped to the lathe faceplate and the ball indicated until it runs true, after which the ball and plug are removed, a short, straight plug substituted, and the master gage located in place again over this plug, being held by solder, when it is ready to have the hole B finished in the usual way.

Finishing Center Hole of Master Gage

The last operation on the master gage is finishing the center hole to size, stock having been left so as to bore the two half holes through solid steel. The gage is held in a cast-iron spring chuck of the "step" variety, and the hole is roughed out. But as these chucks are not absolutely accurate, the finishing is done in a brass chuck like that shown in Fig. 11. This chuck consists of a special lathe collet A, to one end of which is screwed and soldered the piece of brass B. The collet is placed in the lathe and the brass piece bored out to within a couple of thousandths inch of the size of the outside diameter of the master gage. It is heated with an alcohol lamp

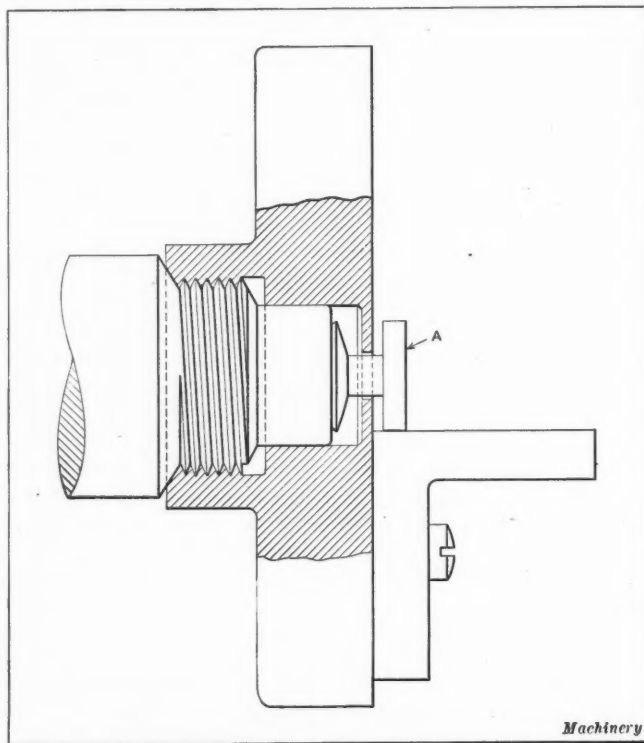


Fig. 6. Angle-plate used to support Master Gage when it is being ground

until the gage will slip into it, and is then cooled with a piece of waste dipped in water; the shrinkage of the brass will hold the gage securely and accurately. The gage is then bored in the regular way, care being taken on the last few cuts not to break down the corners of the two half holes. In boring, 0.01 inch is left for finishing with the bench lathe grinder, and in this operation from 0.0002 to 0.0005 inch is left to be taken out with a lap. When lapped, the gage is ready for use.

Making Working Gages

In making the working gages, practically the same methods are used. These gages consist of a base A, Fig. 4, a hardened tool steel locating and gaging nose B, to which are screwed and doweled the half-hole gaging parts C, and hardened steel block E, which is screwed and doweled to the base.

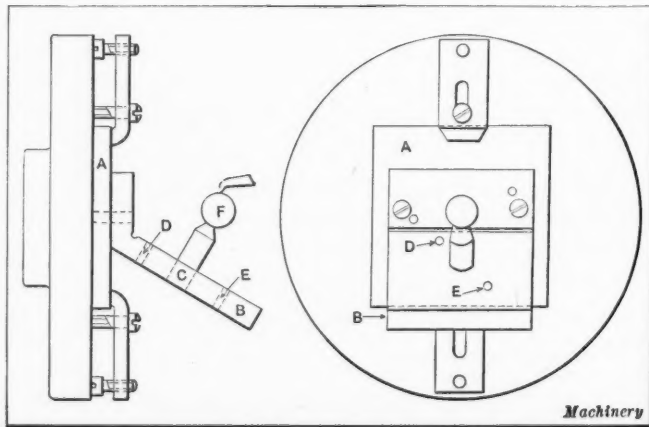


Fig. 7. Special Master Plate for holding Master Gage

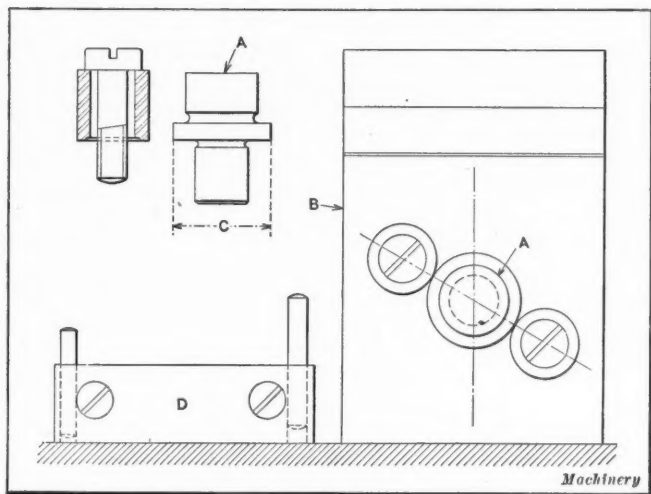


Fig. 8. Plugs for locating Half Holes in Master Plate

In addition there are four hardened, ground and lapped plugs, only two of which are shown; the other two are double ended "Go" and "Not Go" gages for the half holes.

To make this gage, the base *A* is first machined, the two flat sides being ground parallel and smooth; then the 5/16-inch hole in the center is bored, after which the block *E* is made in the usual way, placed on the base and located approximately. After the screw holes are located, drilled and tapped, the piece is fastened lightly in place and lined up properly with the center hole in the gage base. It is then fastened securely by the screws, and the dowel-pin holes are drilled and reamed and the dowels placed in them.

The next step is machining the center plug, or locating nose *B*, which is done in practically the same manner as was described for the master gage, using the same master plate and master angle. A piece of tool steel is roughed out and a hole 0.002 inch less than 5/16 inch is bored and reamed in the center. The piece is then placed on a mandrel and the outside turned to within 0.01 inch of size and the top and bottom are faced off. The bottom, being slightly under-cut, leaves a rim 0.004 or 0.005 inch around the edge. This edge makes it impossible for any bulging, caused in hardening, to prevent the bottom from being lapped to a true surface again without grinding on the surface grinder. After the piece is turned and faced, it is removed from the mandrel and placed on the milling machine, and a 5/16-inch slot, 1/4 inch deep, is milled across the face to take the two pieces that are to gage the two half holes. Screw and dowel holes are then made in it. In boring the angular hole, the same methods and fixtures are used as in making the same hole in the master gage. After this hole is bored and reamed, the piece is hardened. The scale is then lapped out of the center hole, and a short piece of drill rod is caught in the lathe chuck and ground in place until the piece can be wrung onto it. In this position the piece is ground to within 0.0005 inch of size and then lapped, to remove the remainder. Next, the two pieces of soft tool steel are fitted to the 5/16-inch slot milled across the face of the plug, leaving enough projecting at each end so that when the half holes are being made there will be stock all around to support the reamers, etc. In making these holes, the master plate used in making the master gage is again used. In boring, about 0.002 inch is left in the

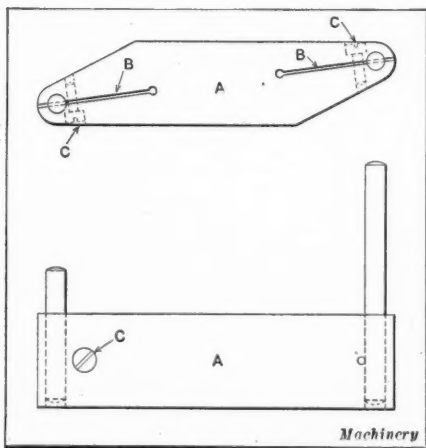


Fig. 9. Tool for locating Plugs shown in Fig. 8

holes, so that after they are hardened and replaced, they can be again set up and ground with a diamond-charged lap used in the bench lathe traverse spindle grinder. Afterward the surplus stock on the ends of the inserted pieces is ground off on the tool grinder freehand, the final finish being given by placing the piece that carries them over a plug, previously ground in the lathe chuck, and finishing with the bench lathe grinder.

The gage is then ready to assemble. This is done by placing the gage over a 5/16-inch plug that is inserted in the hole in the base. Then the master gage is placed over it and the two plugs of the proper size are inserted in the two half holes and in the corresponding holes in the working gage, while a third plug is put through the block *E* and entered into the proper hole in the master gage. In this position, the center plug, or locating nose of the working gage, is ready to have the dowel and screw holes transferred to the base. After these holes are finished, the dowels inserted and the nose secured

by the screws, the gage is ready for use. The angular hole, and all others that are likely to become out of true in hardening and which cannot readily be trued up by other means, are ground out by using a diamond lap where they are too small for an emery wheel to be used.

Height Limit Gage

At *B*, Fig. 12, is shown a limit gage for testing the height of the under-cut *A* in the fuse cap, Fig. 1. For the benefit of those who like to work out interesting and practical problems in toolmaking that require a knowledge of simple shop trigonometry, the dimensions of the gage and the cap are given here just as the workman gets them. The gage consists of five pieces; *A* and *B* form the body and are doweled and riveted together by the pin *D*, which is a snug-fitting piece of drill rod. Pins *C* are driven into body *B*, the center hole being for clearance to allow the pins to be driven out.

Fig. 15 shows the master plate on which the two parts forming the body were made. This consists of a flat plate *A* ground parallel on the sides and two long edges. In it are

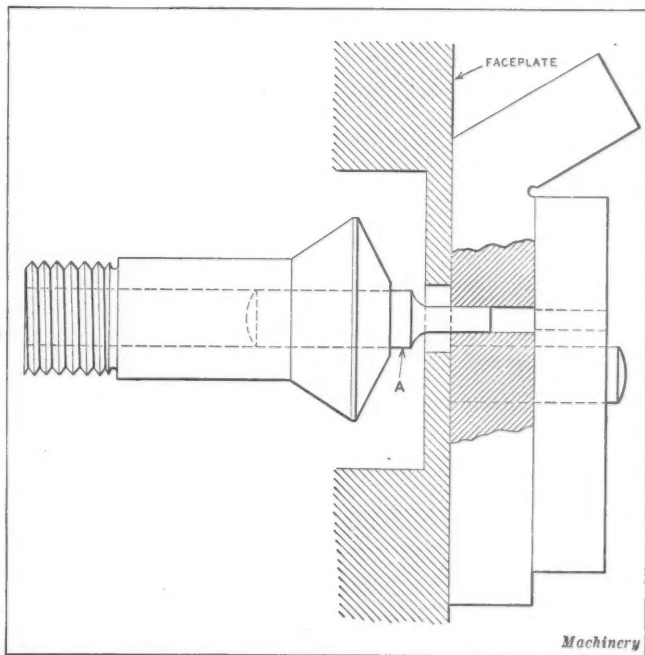


Fig. 10. Special Collet used in making Master Gage

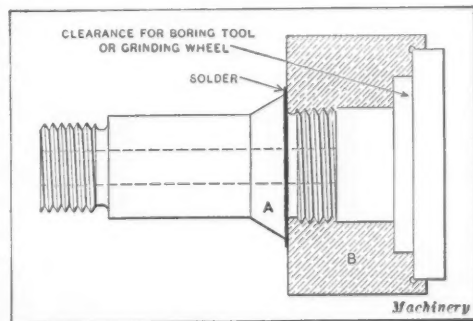


Fig. 11. Brass Chuck for holding Master Gage

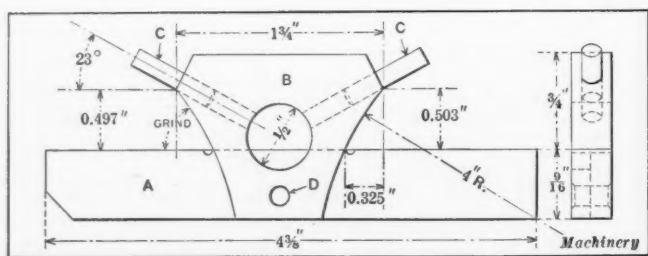


Fig. 12. Gage for testing Under-cut in Fuse Cap

bored four holes *B*, *C*, *D* and *E*, and two pins *F* and *G* are located on it. The positions of the holes, of course, are found by calculations involving trigonometry. After the dimensions have been found, the plate can be laid out roughly, the holes drilled and tapped, and jig buttons screwed in place and then located accurately by using micrometers, a height gage, or other convenient means. In this case, the hole *B* was first located approximately and the center punched. Then the plate was swung on the faceplate of a lathe, and the hole drilled, bored and reamed to size, but without taking any particular pains to keep it in exact relation to any other part of the plate, as it was afterward to be used as a starting point.

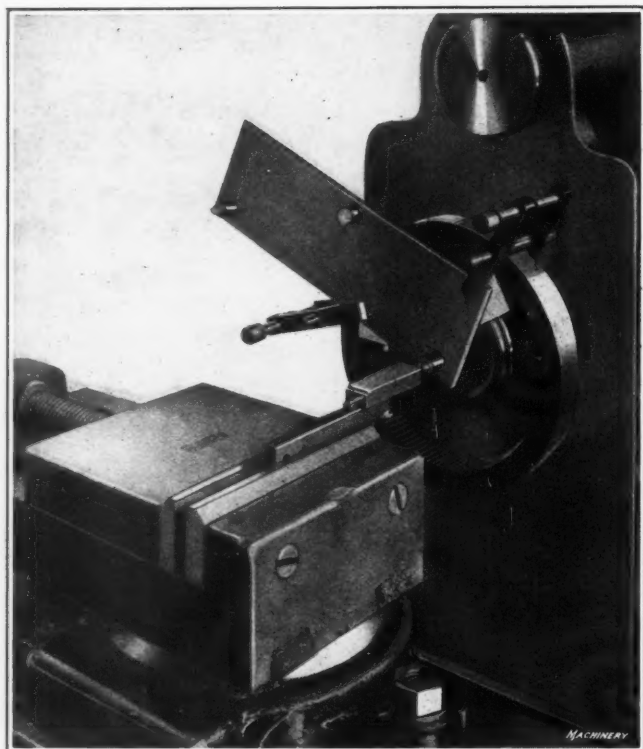


Fig. 13. Locating Holes on the Master Plate

After hole *B* was finished, the jig buttons were put in place and accurately located for holes *C* and *D*. As we had no engine lathe large enough to swing the plate when these holes were being bored, a milling machine was used, as shown in Fig. 13. Lacking a proper faceplate for this machine, a large internal gear that was part of a high-speed milling attachment was put in place on the machine and a light cut taken off its inside face to make sure that it ran true, holding a lathe tool in the miller vise. Two blocks that had been ground square on the surface grinder were then placed against the trued face of the gear, and the master plate was clamped back against them as shown; then the buttons were trued up by the indicator, which was held fast in the miller vise. After truing them, the work was clamped more securely, again indicated, and the

buttons were removed; a boring tool was put in the miller vise in place of the indicator, and the holes were bored true, using the milling-machine feeds.

After the end holes *C* and *D*, Fig. 15, were finished, plugs were inserted and the button for hole *E* was put in place and trued up from holes *C*, *D* and *B*. As hole *E* is in the center of the plate, it was bored in the engine lathe in the regular way. The pins *F* and *G* were then located. No particular pains were taken with these, as they were under-cut next to the plate; they were then ground on the surface grinder, the plate being stood on edge to get the proper dimension from hole *B*. Next a drill bushing was inserted in the center hole *E* and a plug in hole *B*.

The piece *B*, Fig. 12, having previously been roughed out of tool steel and the center hole having been bored on the

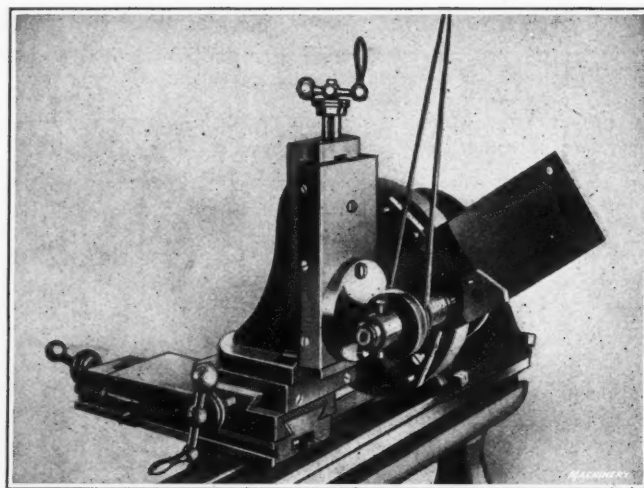


Fig. 14. Milling Edges of Gage and Slots on Master Plate

bench lathe and lapped to a plug fit, was placed over the plug in the hole *B* on the master plate, clamped fast, and the dowel-hole spot-drilled, drilled and reamed through the drill bushing *E*. Next, the four-inch radius was milled, about 0.005 inch being left on a side to be ground off. The milling was done on the bench lathe, as shown by Fig. 14. Plugs were inserted through the work and the holes *E* and *B*, Fig. 15, in the master plate, while another plug was trued up in place in the lathe spindle from which to swing the plate from either of the corner holes *C* or *D*, using the lathe milling attachment as shown. During this operation, the two clearance slots *H* in the master plate were milled so as to allow a grinder wheel to pass over the work on the following operations.

Next the bar *A*, Fig. 12, is milled to receive the piece *B*. This slot is roughed out on the regular milling machine and finished on the bench lathe to within 0.005 inch, using the master plate and the bench lathe milling attachment, as previously described, and locating from the dowel-hole *D*, which has been drilled and reamed, and the two pins *F* and *G*, Fig. 15. Next comes the boring and reaming of the two holes for the pins *C*, Fig. 12. Figs. 16 and 20 show how the part *B*, Fig. 12, is located on an angle-plate over the two pins that

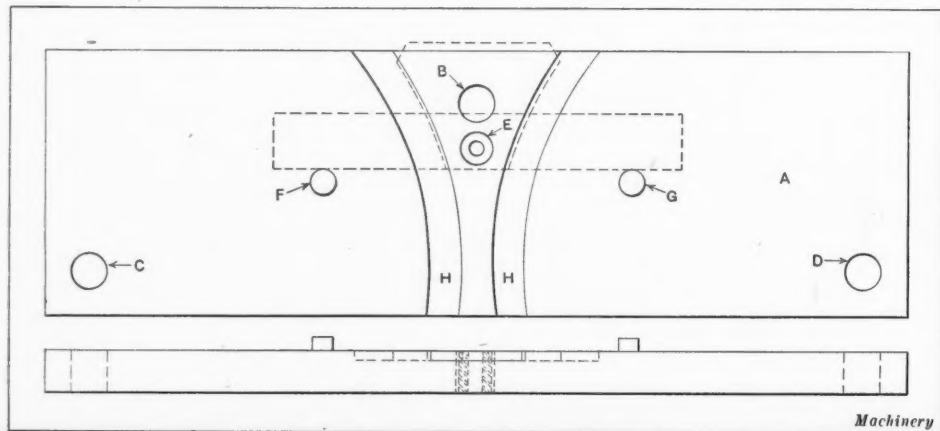


Fig. 15. Master Plate for making Gage shown in Fig. 12

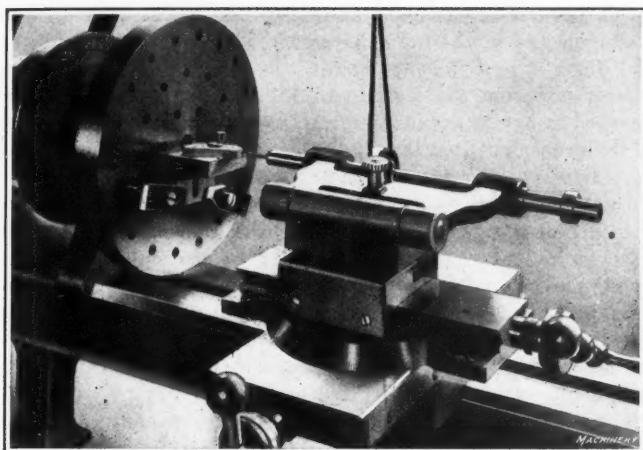


Fig. 16. Lapping Holes in Ends of Gage

were accurately located for holding the piece in the proper position. After the holes are reamed for the pins, the piece is taken to the milling machine and the end milled where it is to fit on the bar, enough stock being left for grinding after hardening. All the pieces are now ready to harden. After hardening, red-hot tongs are used to draw out those parts that are to be joined together so as to eliminate, as far as possible, any chance of their breaking at this point.

Next the holes for pins *C* are lapped out and temporary pins driven in place, after which the work is taken to a surface grinder and the sides ground parallel with these pins. Then the center holes and the dowel-holes are lapped out until the pieces can be put back in place. Fig. 16 shows the final finishing of the two pin-holes with a diamond lap, using the bench lathe traverse spindle

grinder. Next the four-inch radius is ground on both parts *A* and *B*, Fig. 12. This work is done on the bench lathe, using the master plate swung from the center plug and the tool-post grinder, as is shown in Fig. 17. The lathe is turned back and forth by hand and the measuring is done from the center plug to the side of the radius with a vernier to get the exact radius. Parts

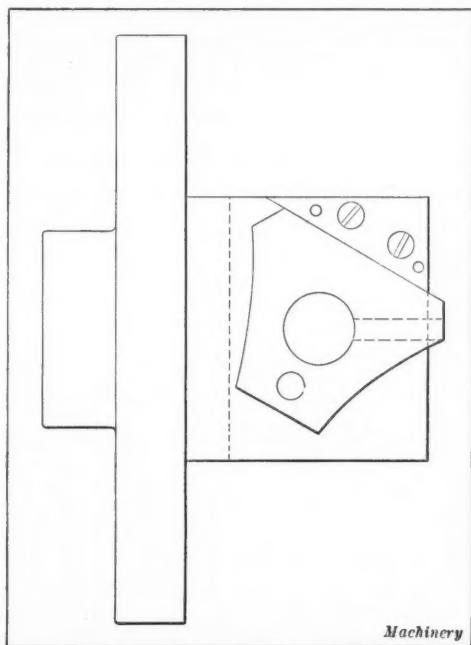


Fig. 20. Holding Gage for boring and lapping Holes in Ends

A and *B* are then fitted together and the dowel-holes lapped true with each other and a tight fitting dowel inserted, but not headed over. Getting the dimensions 0.503 and 0.497 inch is then a matter of calculation and measurement from a plug inserted in the center hole in part *B* to the face of bar *A*, then removing *B* and grinding *A*. After assem-

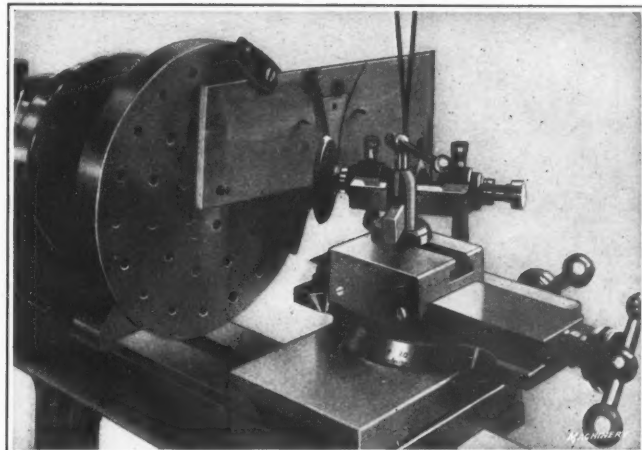


Fig. 17. Grinding Four-inch Radius on Gage

bling them and inserting and heading the dowel, the gage is finished.

Flat Gage for Measuring Depth of Slot in Fuse Ring

At *A*, Fig. 21, is shown a gage that puzzles the average toolmaker. It is a simple flat gage used to measure the depth of a milled slot *B* in the fuse ring; α is the angle of the edge of the ring, and *D* and *E* the dimensions given by the part drawing. The dimension *X* is determined by calculations involving simple shop trigonometry, but measuring this dimension on the piece is another matter. As it cannot be done directly with micrometers, a master gage *A*, Fig. 18, must be made. This, at first, seems to be as hard a proposition as the working gage, but actually is much easier. A piece of Brown & Sharpe ground tool

steel is roughed out to approximately the shape shown, leaving enough to grind, and is then hardened. It is then placed on a surface grinder, and after the sides and edges, and the surfaces *B* and *C* are ground, the angle is ground and dimension *X* made correct.

But before this can be done, a master angle-block must be made. This block, shown in Fig. 19, is made of machine steel and is ground perfectly square and parallel on the ends and sides. The angle is obtained with the aid of a sine bar and an accurate angle-plate. When this block is finished, the master gage is clamped to it while the angle is ground on a surface grinder. To make dimension *X* correct, a hardened and ground plug *D*, Fig. 18, is made, the outside diameter and the point being ground at one setting, so as to have the point exactly concentric. The point is rounded with a fine Arkansas oilstone to remove any slight burr

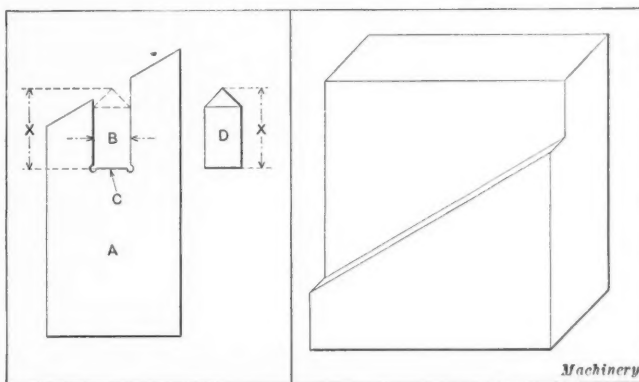


Fig. 18. Master Gage for making Gage shown in Fig. 21

Fig. 19. Master Angle-block for making Master Gage shown in Fig. 18

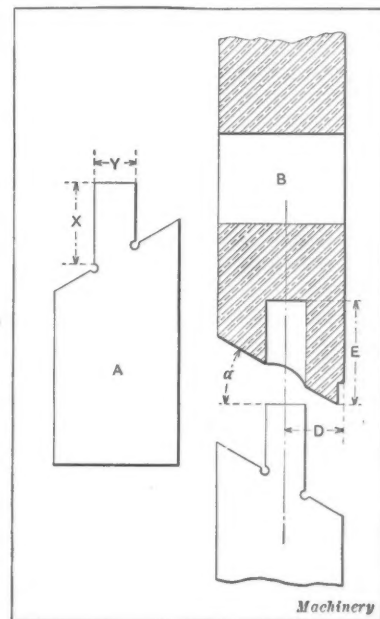


Fig. 21. Flat Gage for measuring Milled Slot in Ring

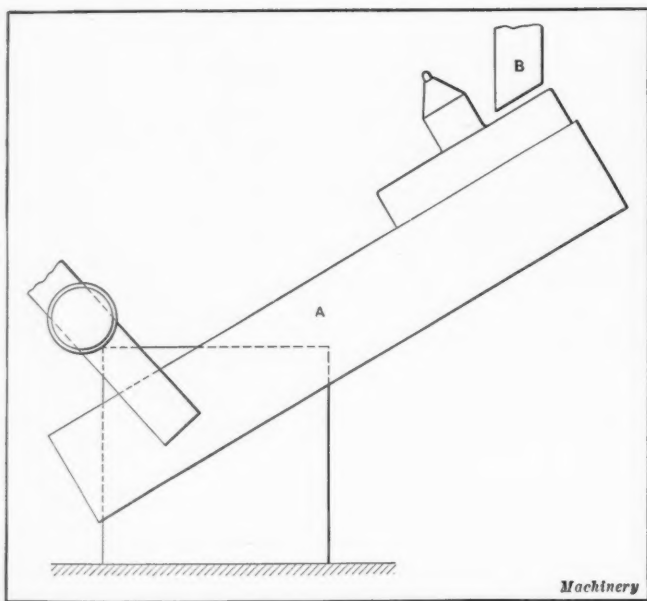


Fig. 22. Using Master Angle-block to get True Angle on Grinding Wheel

or sharpness that can possibly interfere when measuring across it with a micrometer. Care must be taken to remove no more than is necessary. After grinding the outside and the point, the other end is ground, either in the bench lathe or the surface grinder, whichever is most convenient or accurate, until the plug is the proper length. Then the master gage is laid flat on a surface plate and the plug is pressed between sur-

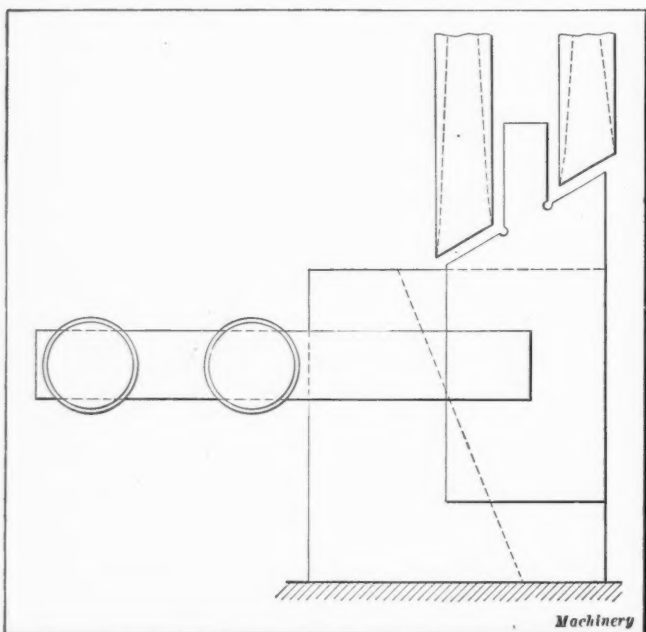


Fig. 23. Method of clamping Gage to Master Angle-block

faces *B* and against surface *C*, as shown by the dotted lines, and secured in that position by a drop of melted wax. This wax is made by melting together one part of beeswax and one part of rosin. When the master gage is secured to it, the master angle-block is taken to the surface grinder and ground on the angle until a straightedge will rest on the angular surface and the point of the plug. Great care must be exercised not to grind off too much, as the point of the plug is so small that a ray of light shining through between it and the straightedge may appear to be several thousandths inch, when in reality it is no more than 0.0001 or 0.0002 inch. After the angle is properly ground, the master gage is ready for use.

The working gages are roughed out of Brown & Sharpe ground stock, no particular pains being taken with them other than to leave enough stock on the working faces to grind, after which they are hardened. They are then ground true and parallel on the sides and edges. In order to grind surfaces *B*, Fig. 18, and the angular faces, the master angle-block is set

up on the surface grinder, as in Fig. 22. After a parallel *A* is clamped to it, the diamond emery wheel dresser is slid up and down it past the face of the wheel *B*, thus obtaining the correct angle on the wheel. In Fig. 23, the work is shown clamped to one of the plain surfaces of the master angle-block, in the proper position to grind; the wheel, besides being trued on the face to give the proper angle, is under-cut on the sides with the diamond, as shown by the dotted lines.

In grinding surfaces of this kind, the grinder spindle must have no end play, so it is customary to use a piece of hard wood, sharpened to a blunt point, in the spindle center and keep the spindle in the proper position by lightly pressing against it. If much work of this kind is to be done, a flat spring secured to the wheel guard and pressing against the end of the spindle may be made to answer. After surfaces *B*, Fig. 18, are ground, the angular faces are ground. As these faces must be parallel and perfectly in line, it is difficult to grind them on the surface grinder, so the bench lathe is used.

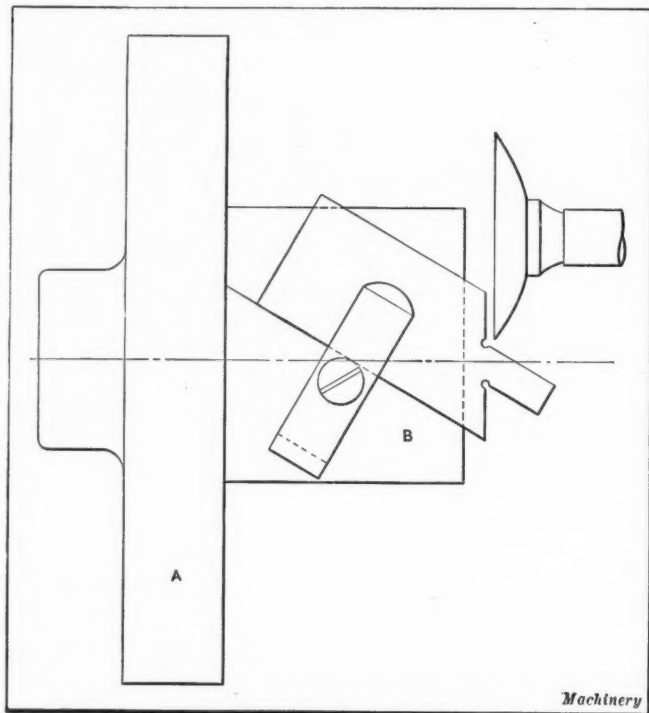


Fig. 24. Grinding Gage in Bench Lathe

In Fig. 24, *A* is the faceplate and *B* is the master angle-block, to which the gage is clamped, which, in turn, is secured to and swung from the faceplate of the lathe. The grinding is done with the bench lathe grinding attachments, either the traverse spindle or toolpost grinder being used. Lastly, the end of the gage has to be ground to make dimension *X*, Fig. 21, correct. This is set up as shown in Fig. 23, only using a straight wheel and trying the work with the master gage.

Gage for Testing Counterbore of Angular Hole in Fuse Body

Fig. 25 shows a gage for testing the depth of counterbore of the angular hole *A* in the fuse body, Fig. 3. This consists of the body into which pins are driven. All the parts are of tool steel and are hardened and ground. The hole through the center provides means for driving out the pins easily. The difficulties

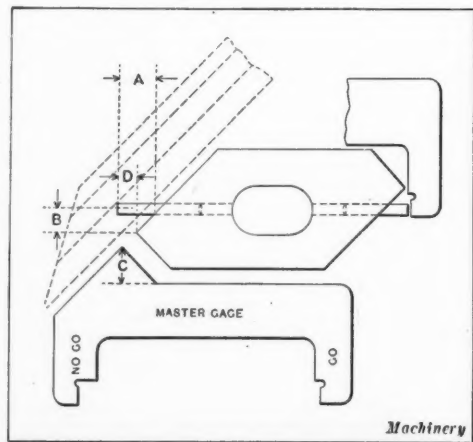


Fig. 25. Gage for Depth of Counterbore of Angular Hole in Fuse Body

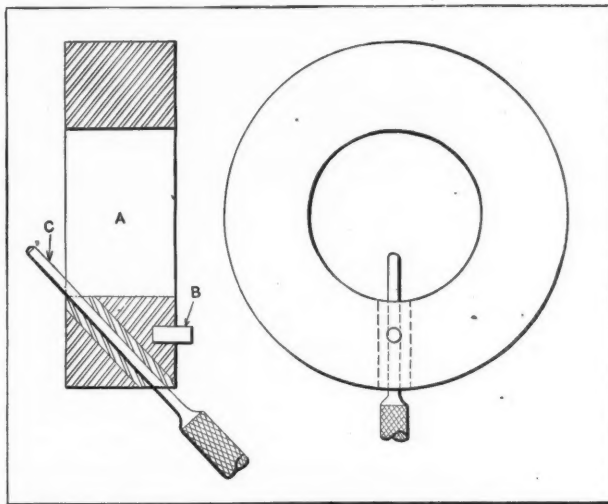


Fig. 26. Gage for locating Angular Hole drilled in Stem of Fuse Body

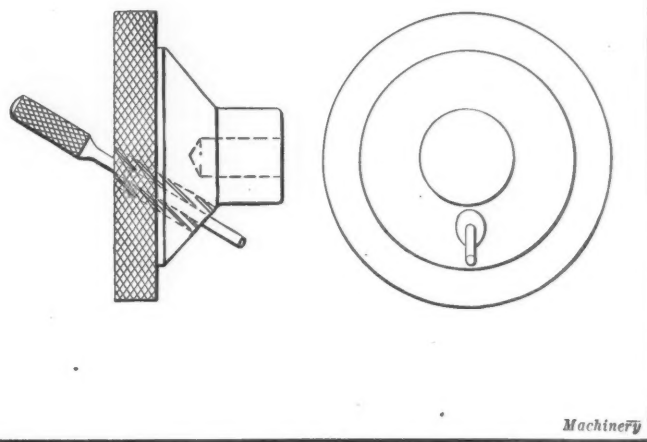


Fig. 27. Gage for locating Angular Hole, Similar to that shown in Fig. 26

met in making a gage of this type are in getting the dimensions *A* and *B* correct, as neither of these may be obtained direct with ordinary measuring tools.

The method of making these gages is as follows: First the body is roughed out, taking care only to see that the two pins are kept in line with each other. Then the body is hardened, the holes lapped out to receive the pins, the pins put in temporarily, and the sides and edges ground parallel with these, care being taken that both the edges are a given distance from the pins. The pins are then removed and the work is clamped to a master angle-block and the longer of the two oblique sides ground.

Before finishing the short sides and getting dimension *B*, it is necessary to make up the master gage, which may be used to test the working gages. The angles on this master

gage are generated by a sine bar and an accurate angle-plate, grinding them on a surface grinder. The measurement *C*, which is the difference between *B* and the edge of the

working gage, is easily obtained with a micrometer. The "Go" and "Not Go" ends of the master gage, which are used to test the length of the pins, are ground in the usual way, as they can be measured direct with the micrometer.

When the short oblique side of the working gage is to be ground, the gage is clamped fast to a master angle-block, set up on the magnetic chuck of a surface grinder and ground little by little. The master gage and a knife-edge straightedge are then used to test it, as shown, until the

two edges are perfectly in line. A variation of 0.0002 inch between the master and the gage will look large when they are held to the light. After finishing the angle, which makes

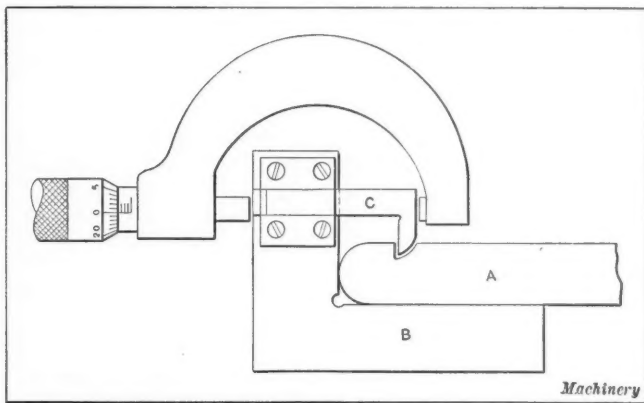


Fig. 28. Testing Slot in Relation to Radius

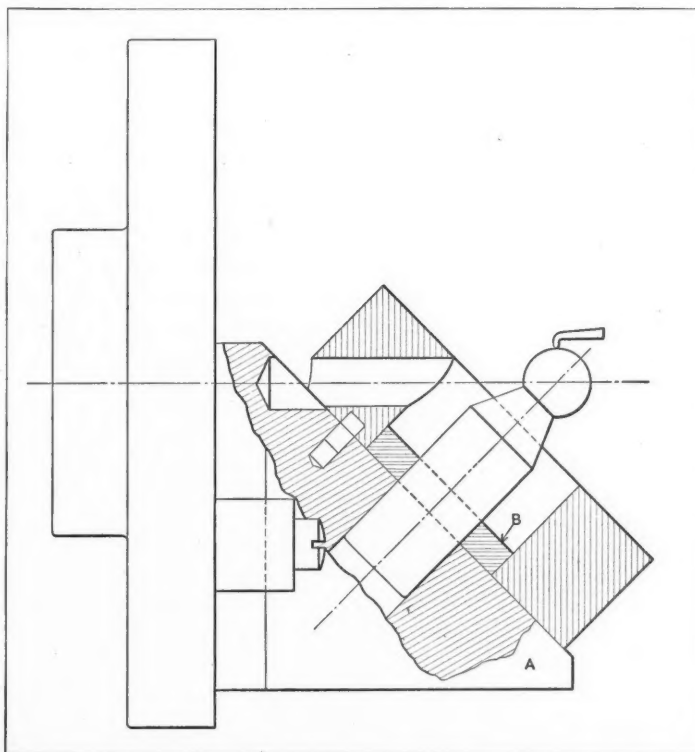


Fig. 29. Method of handling Gage shown in Fig. 26

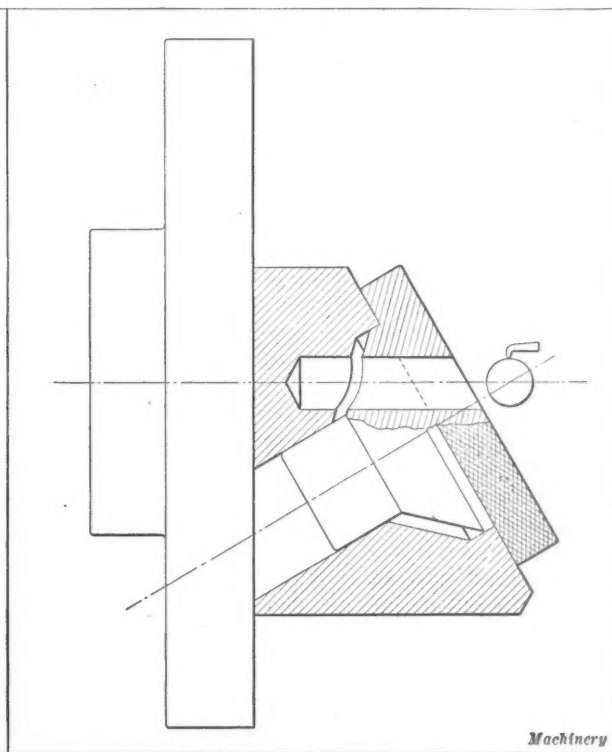


Fig. 30. Method of handling Gage shown in Fig. 27

dimension *B* correct, the hardened pins are driven in, leaving just enough projecting to grind. Then, squaring up on an angle-plate, the pins are ground off, the master gage being used to get the dimension *D*, which has been found, by trigonometry, to bring dimension *A* right and finish the gage.

Testing Slot in Relation to Radius

Fig. 28 shows a method of measuring a slot in relation to a radius that it is desired to make more accurate than can be done with a height gage or other ordinary means. *A* is the piece to be measured; *B*, a special square of hardened and ground steel; *C*, a smaller square made to fit and slide perfectly in a slot in the larger square and held in place by a flat plate screwed on, as shown. All parts of the tool are made as accurately as possible. The manner of using is clearly shown; the width of the square ends are subtracted from the over-all dimension found by the aid of the micrometer.

Miscellaneous Examples of Gages and Jigs

Figs. 26, 27 and 29 to 32, show other examples of gage and jig work. Fig. 26 shows a ring *A* that fits over the stem of the fuse body and down onto the platform, where it is located from the pin *B* that fits into a hole in the platform. The pin *C* is used to gage the location of an angular hole drilled through the stem. The method of handling this gage is as follows: After roughing out the ring *A*, allowing for grinding and locating the pin *B*, it is transferred to a master angle-plate *A*, Fig. 29, which, in turn, is clamped to a bench lathe faceplate, as illustrated. This angle-plate has been previously ground perfectly true on the surface grinder, using a sine bar to make the angles correct; it also has two holes accurately located in it, one for centering the gage and the other for receiving pin *B*. When the angle-plate has been properly positioned on the lathe faceplate by means of the ball plug, as shown, the latter is removed and another plug inserted; over this plug is placed a ring *B* that is used to locate the gage. The remainder of the work is performed as has been previously described.

Fig. 27 shows a somewhat similar gage, while Fig. 30 shows the method of handling it on a master angle-plate, using a ball plug as described for the other gages. In all cases, due allowance must be made for grinding all over after hardening and repeating all operations on surfaces that are to be very accurate.

Fig. 31 illustrates a jig for drilling an angular hole in the stem of the fuse body, this being the hole for which the gage shown in Fig. 26 is used. This jig was made in two pieces, being split on center line *A* on account of trouble experienced from drill breakage. When solid jigs were used and drills broke, they wedged the body fast in the jig and it was difficult to remove them; but by making the jig in two pieces, the upper part can be removed, and the drill easily extracted without removing the jig proper from the drill-press table.

The method of handling this jig is to fasten an angle-iron *B* to the back side of the jig, then set it up in a lathe, or milling machine, and finish-bore the hole *C*. At the same setting, angle-iron *B* is bored to take the ball plug *D*, thus having the ball plug exactly central. The ball is easily set to the exact apex of the angle by using the depth micrometer *E* from the face of the jig. After the ball is set, the jig is swung up on a lathe faceplate from the surface *F*, the top half of the jig is

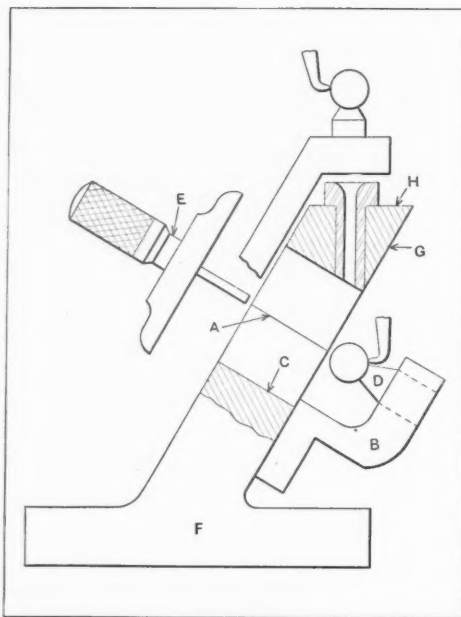


Fig. 31. Jig for drilling Angular Hole in Stem of Fuse Body

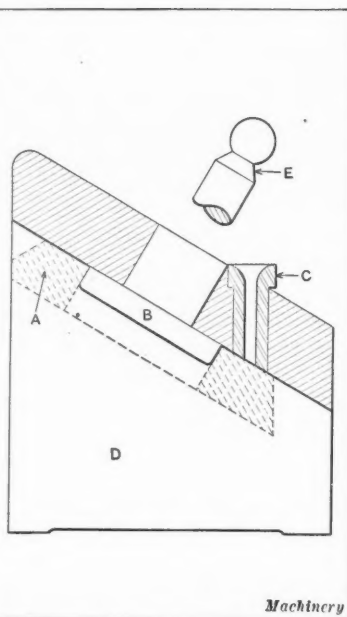


Fig. 32. Jig for drilling Angular Hole in Fuse Ring

removed, so that the ball can be reached by an indicator, and the ball indicated until it runs true. The top half of jig *G* is then put back and bored, reamed, etc., in the regular way.

If the jig had not been made in two pieces, the setting could have been accomplished by locating the ball as already described and then using a second ball fastened to a piece as shown at the top of the view, and transferring the location by means of an indicator, height gage or other means. Another method is to locate a jig button

on face *H*, using the ball for transferring the location.

Fig. 32 shows a drill jig for drilling an angular hole in a time-fuse ring. The ring *A* is located over the plug *B*, which, with the drill bushing *C*, is driven into the jig body *D*. The manner of using the ball plug *E* at the apex of the angle is clearly shown.

* * *

RHOTANIUM—A PLATINUM SUBSTITUTE

Rhotanium, a palladium-gold alloy in which the gold content varies from 60 to 90 per cent, is said to form a satisfactory substitute for platinum. It is malleable and ductile and can be welded without the use of a flux or other reagent. Its specific gravity ranges from about 16 to 18.5, according to composition, and its losses by volatilization at temperatures below 1300 degrees C. are less than those of commercial platinum. It can be used, within its temperature limitations, in electric heating units, and is satisfactory for contact terminals in many forms of automatic electric devices. Its behavior when tested on certain magnetos was satisfactory, but experiments performed on a high-grade aeroplane-engine magneto gave negative results. It is not suitable for use with hot concentrated nitric acid nor for electrolytic anodes, but for all other chemical purposes it is entirely satisfactory if the proper composition is chosen and if properly manufactured. Certain of the alloys have given good service in dentistry when used for pins and baked into porcelain teeth and as thin foil and heavy sheet for other types of construction. Rhotanium is said to be superior to pure platinum for use in jewelry; it is harder, stronger and takes a better finish. It does not tarnish, is non-corrodible, has practically the color of platinum, and can be worked as readily. Jewelry made with it passes the common jewelers' and platinum buyers' tests.—*U. S. Commerce Reports*.

* * *

Sir Francis Fox told the Royal Geographical Society, of Great Britain, that one of the difficulties in planning the actual route of the Channel tunnel was to keep the tunnel well within the thickness of the gray chalk. Because of this the tunnel would not be quite a "bee line." The maximum depth of water over the tunnel would be from 160 to 180 feet, and the roof of chalk over the structure had been fixed at a minimum of 100 feet. A dip in the level of the rails would form a water lock, so that a mile of the tunnel could, in case of emergency, be filled with water. The mechanism for doing this would be controlled from Dover Castle, and the entrance and exit of both tunnels would be under the gunfire of the Dover forts. By means of the tunnel, it was stated trains would run direct from London to Paris in less than six hours, and it would be possible to go from London to Constantinople, Petrograd, and by the Serbian express to the Far East.

LETTERS ON PRACTICAL SUBJECTS

We pay only for articles published exclusively in MACHINERY

DETERMINATION OF BLANK DIAMETER FOR DRAWN METAL SHELL

In some shops, the determination of the diameter of the blank for a shell of given diameter and depth is a matter of guess or "cut and try," although there are tables that give this information. However, all the tables that the writer has seen have been made by calculating the blank diameters for various sized shells by the formula $D = \sqrt{d^2 + 4dh}$, in which D is the diameter of a blank for a shell having a diameter d and a height h . It is obvious that the area of the blank must be equal to the area of a circle having a diameter d and the lateral area of the shell. Then, as the area of the circle

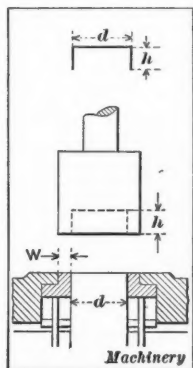


Fig. 1. Shell and Blank-holder

with a diameter d is $\frac{\pi d^2}{4}$, the lateral area is πdh , and the blank area is $\frac{\pi D^2}{4}$;

$$\frac{\pi D^2}{4} = \frac{\pi d^2}{4} + \pi dh, D^2 = \frac{4}{\pi} \left(\frac{\pi d^2}{4} + \pi dh \right), D = \sqrt{d^2 + 4dh}.$$

But this formula does not take into consideration the "draw," or stretch, of the metal that takes place during the stamping operation. This draw is in proportion to the depth of the shell and is different for different metals. To determine the blank diameter for a zinc shell of known depth and diameter, made in one drawing operation, the chart shown in Fig. 2 will be found accurate. This chart is made with each division representing 1/64 inch. The abscissas represent the depth h of the shell, Fig. 1, and the ordinates, the width W of the blank-holder. For example, suppose that it is desired to find the blank diameter of a shell 2 inches in diameter and 13/16 inch deep. Now 13/16 inch is 52/64, so following the vertical line from 52 to the curve and reading the horizontal line that it intersects at that point, the width W of the blank-holder is

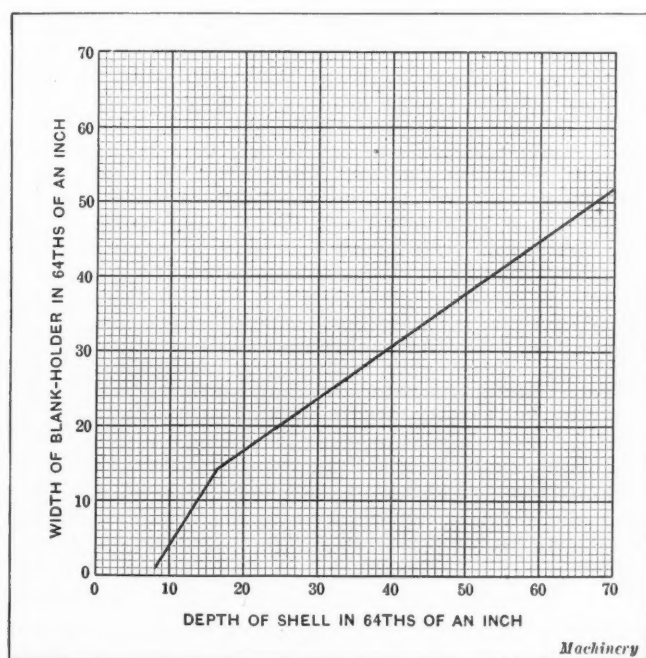


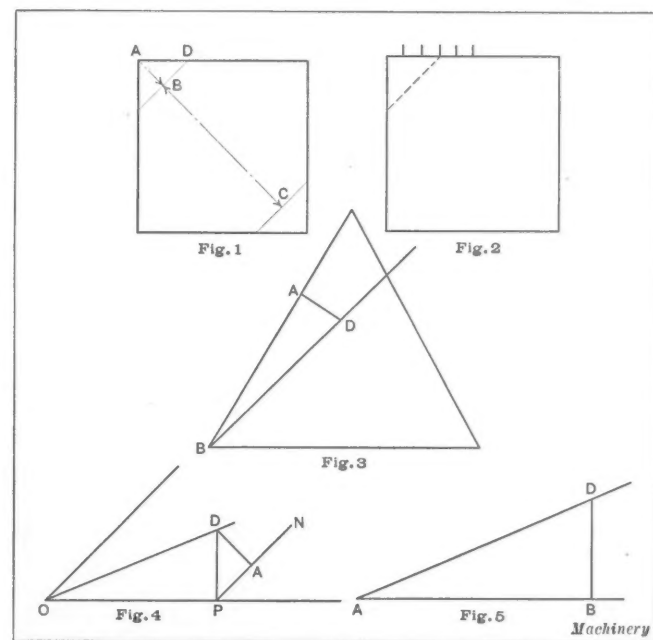
Fig. 2. Chart for determining Blank Diameter of Zinc Shell

found to be 39/64 inch. $39/64 \times 2 = 17/32$, which, added to the diameter 2 inches, gives a blank diameter of 37/32 inches. Wheeling, W. Va. H. S. BRADY

MAKING SQUARE STOCK OCTAGONAL

In the machine shop, if a piece of square stock is to be made octagonal, it is necessary to know either the depth of cut AB , Fig. 1, or the thickness BC of the collars between the straddle-mills. To the carpenter, however, the problem presents itself in a different light. He cares for neither of these measurements, but needs AD , so that he can scribe a line to guide his saw and plane.

The methods employed to obtain this dimension are interesting. Some of the men with whom the writer has conversed



Figs. 1 to 5. Diagrams showing Methods used in making Square Stock Octagonal

say that they take AD equal to one-third the side of the square, and "don't cut quite to the line." This is undeniably an easy scheme, but about as accurate as the proverbial "blacksmith's hairbreadth," the actual value of AD being not side $\times 1/3$, but side $\times 0.2929 +$. Others adopt the plan, shown in Fig. 2, of dividing half the side of the square into fifths and taking the third division from the corner as the starting point for scribing the line. This is not so inaccurate a method as the first, 0.3 being, probably, near enough to 0.2929 + for wood-working purposes, except in the more exacting branches of work.

Another plan is to lay out an equilateral triangle, as in Fig. 3, then with the miter square subtract 45 degrees from it. The length of the side of the square is then laid off at BA , and the perpendicular AD erected, its length being taken for AD in Fig. 1. This, also, is only an approximation, giving side $\times 0.2588 +$. Some workmen, however, follow a method that is theoretically exact, as it gives the true value: $AD = \text{side} \times \tan 22 \text{ deg., } 30 \text{ min.,} \times \sin 45 \text{ degrees}$. Laying out an angle of 45 degrees with his miter square, the workman bisects it with dividers and straightedge, as in Fig. 4. Then making OP equal to the side of the square, he erects the perpendicular PD , which equals side $\times \tan 22 \text{ deg., } 30 \text{ min.,}$ and

drawing NP at 45 degrees to PD , he draws the perpendicular AD , which he takes for AD in Fig. 1.

Various other methods of obtaining AD by construction are in use, but none, so far as the writer is aware, is as quick as the approximate schemes here given, nor as accurate as that given in Fig. 4. Obviously, the 22-degree, 30-minute angle can be used in the solution of two problems allied to this; for if, in Fig. 5, AD is made equal to the diameter of a circular piece, BD will be the side of the included regular octagon. Conversely, if BD is made equal to the side of the octagon desired, AD will be the diameter of the circumscribing circle.

New London, N. H.

GUY H. GARDNER

BLANKING AND FOLDING PUNCHES AND DIES

The shell shown at A , Fig. 1, is made, in two operations, from 16-gage hot-rolled steel. At B , it is shown seated in position, and as it is surrounded by metal, it will not open if an unequal strain should develop. This shell is utilized as a spring seat and retainer; but it has a wider scope of usefulness by reason of its low cost of production. Under ordinary conditions, a shell of these dimensions drawn from a round blank will take five press operations; or, on a basis of 8000 pieces a day, 40,000 operations are required, against 16,000 operations by the folding method. In addition, five separate dies and punches are required, besides the

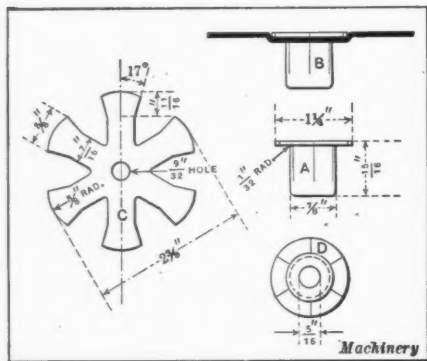


Fig. 1. Blank and Shell formed from it

expense of repairs and extra help. Furthermore, uniform and unstrained walls cannot be guaranteed when dies and punches must often be polished to eliminate the excessive friction caused by the constant rubbing of metal and dies.

The shell A , Fig. 1, is made on an inclined press in one blanking and one folding, or drawing, operation. The blanking is done with the compound punch and die shown in Fig. 2. The advantage of operating this die in an inclined press is that the blanks will drop clear of the die, by gravity, and will be transferred to a receptacle by a chute fastened to the stripper at J . The blank C , Fig. 1, which is made of scrap,

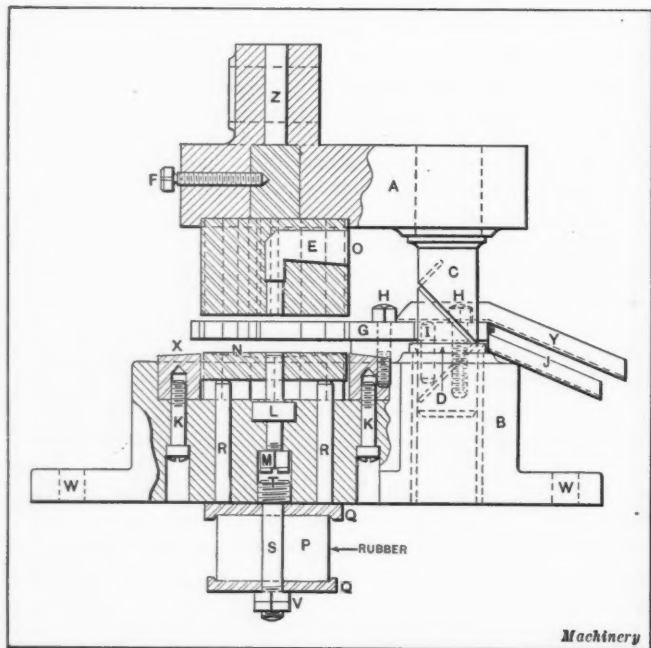


Fig. 2. Blanking Punch and Die

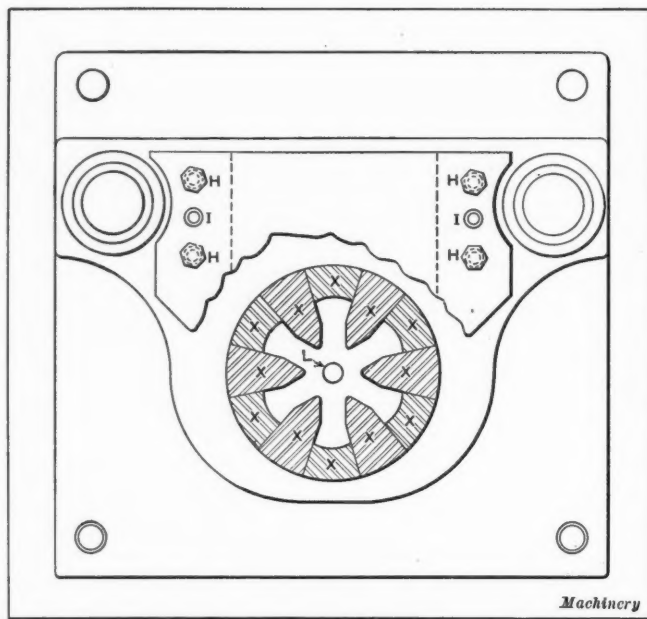


Fig. 3. Top View of Blanking Die

must be carefully developed in size and shape to meet the necessary requirements in dimensions and have all seams tight, as well as to have a uniform and concentric flange, as shown at D , which is a view of the bottom of the shell. This view shows that the hole has opened $1/32$ inch in drawing, which is always taken into consideration in developing work of this nature.

Fig. 2 shows the compound blanking and perforating die, which is of the pillar type; this is easily set up, adjusted, and

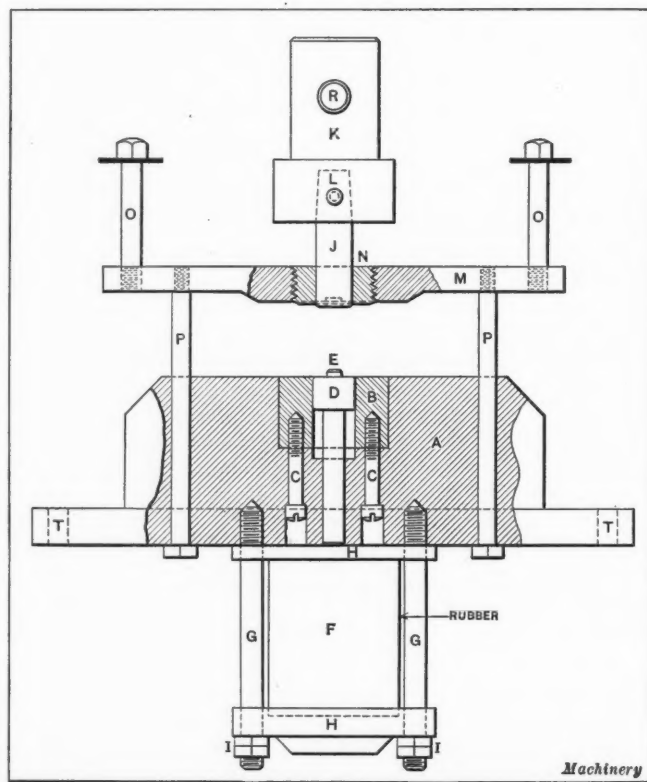


Fig. 4. Folding Punch and Die

put into operation. A is the cast-iron punch-shoe, made to fit the press ram; B is the die-shoe, also made of cast iron. These are held in alignment by guide pins C and bushings D , which are made of tool steel and are hardened and ground. The guide pins C are provided with oil channels to facilitate lubrication; the lubricant used consists of white lead and oil. The punch E is made of hardened tool steel and is held in position by a set-screw F . The hole Z is provided to remove the punch E , when it becomes necessary. Punch E has a clearance hole at O and when operating in an inclined press dis-

charges the slugs over the stripper *G*, which allows them to slide through a chute *Y* to the scrap receptacle. The stripper *G* is held in position by screws *H* and dowel-pins *I*.

The die *X* is made, in sections, of tool steel and is hardened. It is securely held in the die-shoe *B* by reason of the sections being properly fitted and by screws *K*. Fig. 3 shows a top view of the die, which consists of twelve sections *X*; it also shows the clearance under the stripper to allow the blank to leave the die and enter the chute *J*, Fig. 2. The perforating punch *L* is seated in the bottom of the die and is held in position by nut *M*. The ejecting pad *N* receives its motion from a rubber buffer *P*, the force being transmitted through plates *Q* and pins *R*. The rubber buffer is held in position by a bolt *S* screwed into the die-shoe at *T* and tension nuts *V*. Holes *W* are provided for bolting the die to the press, making it unnecessary to use a bolster plate.

Fig. 4 shows the folding, or drawing, punch and die. The die-shoe *A* is made of cast iron and has a seating bushing *B*, held in position by screws *C*. Bushing *B* is made unusually long to increase its life; after the face is ground when the edge becomes worn, a washer is placed under the bushing to raise it to the proper height. This bushing is tapered 0.003 inch to allow the shell to be ejected more easily by the knockout pin *D*. Pin *D* has a gage pin *E* on its face to gage and center the blank previous to drawing it. The knockout pin receives the proper tension from a rubber buffer *F*, which is secured by bolts *G*, plate *H*, and adjusting nuts *I*.

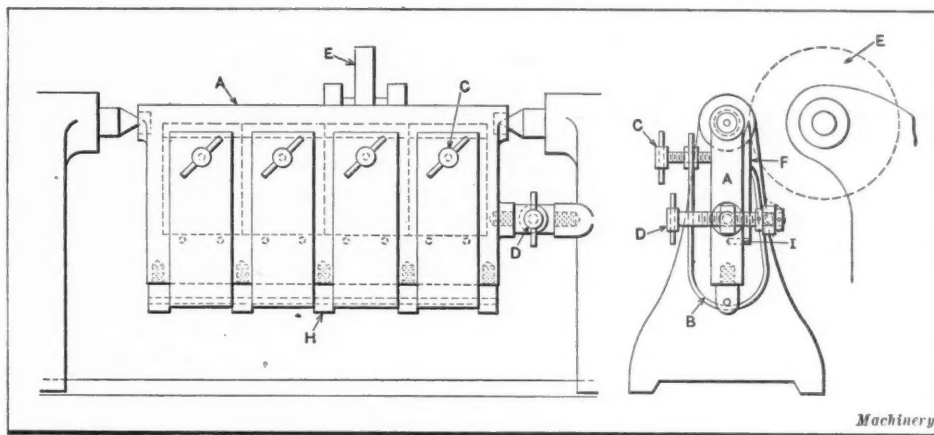
The drawing punch *J* is made of carbon steel and is counter-bored to clear the gage pin *E*. It is held in a machine-steel punch-holder *K* and secured by a tapered pin *L*. The stripper plate *M* is machine steel and has a hardened bushing *N* in the center to flatten the flange of the shell when the punch descends. This bushing also releases the shell from the punch when the latter returns to high center. The adjustment of the stripper *M* is made by bolts *O* and *P*. A pin *R* secures the punch to the ram and prevents it from pulling out under ordinary conditions. Bolt holes *T* are provided for securing the die to the bed of the press.

Highland Park, Mich.

ERNEST A. WALTERS

KNIFE GRINDING FIXTURE

When their edges are to be ground, knives, bayonets or other thin stock may be set up on the centers of a Brown & Sharpe grinding machine or some similar type of grinder. The grinding fixture here shown consists of a cast-iron body *A*, to which spring-steel plates *B* are attached by pivots *H*. These plates are U-shaped and clamp the work *F* to the cast-iron body *A*, the tension being adjusted by screws *C*. The centers are provided with two hardened bushings, which engage the centers of the grinder. The fixture can be set at any desired



Knife Grinding Fixture

angle by adjusting screw *D*. This screw works in pivots, one of which is screwed into the fixture and can rotate to suit the various angles required. The other pivot is screwed into the tailstock in the same way, and is not threaded in the hole. The adjusting screw has two collars, one on each side of the pivot. Stops *I* support the work while it is being ground by wheel *E*, which can be adjusted backward and forward. This fixture has proved to be very rapid and efficient.

Mount Vernon, N. Y.

S. W. PORTS

COATING CASTINGS WITH CHALK

Common white chalk is used extensively as a coating on castings that are to be laid out. Although its application may seem to be extremely simple, some men cannot get the chalk to stay on even if they rub a whole lump into dust and blow it off. The first time over, the chalk sticks fairly well, but the coating is not heavy enough for lines drawn upon it to be easily distinguished; after that the pulverizing begins. Rubbing in this pulverized chalk with the fingers will give a good white face, and one that will stand scribing. When a vigorous rubbing will not make the chalk stay, the old school-boy trick of wetting it will help. Momentarily, the dampened surface looks too gray or black, but blowing on it dries it to its normal white. If a machined cast-iron surface is to be laid out, chalk should only be used when permission has been obtained, as the chalked section is sure to rust—not badly, but enough for it always to be visible unless a cut is taken over it.

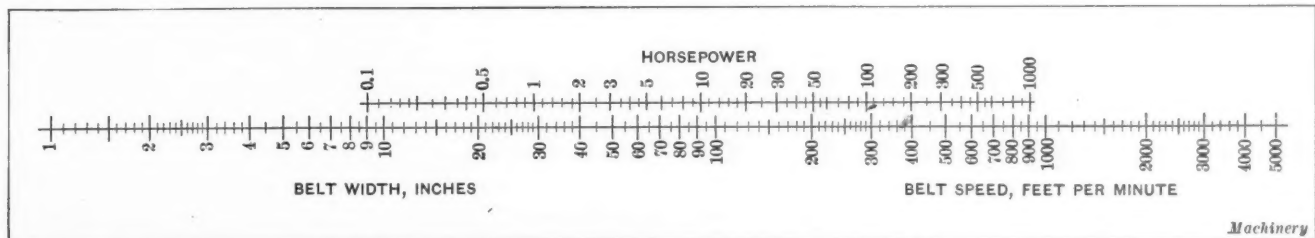
Middletown, N. Y.

DONALD A. HAMPSON

CHART FOR POWER TRANSMITTED BY LEATHER BELTS

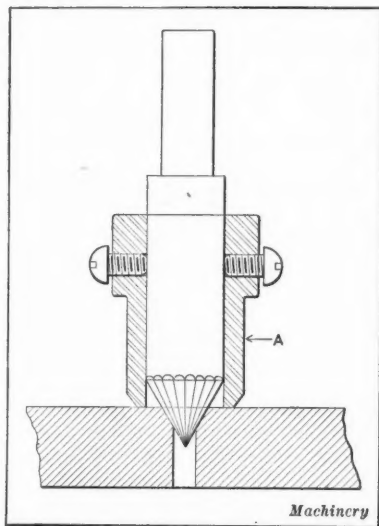
The accompanying chart may be used to determine the width of a single leather belt necessary to transmit any ordinary amount of power, the horsepower that will be transmitted by a single belt running at a given speed, or the speed at which a belt must run in order to transmit a given power. For example, to determine the power that will be transmitted by a single belt 7 inches wide running at a speed of 5000 feet per minute, locate the points 7 and 5000 in the lower graduated line and then find the point midway between them. This point will be found at 44 horsepower on the upper graduated line. The dividing may be done with a rule, or a pair of dividers, or by folding a piece of paper.

Should it be necessary to transmit 44 horsepower by means of a belt traveling at a speed of 5000 feet per minute, the width of single belt required may be found by measuring the distance between 44 horsepower and 5000 and then measuring an equal distance to the left of the 44-horsepower point. In



Power transmitted by Leather Belts

Machinery



Countersink with Sleeve attached for obtaining Accurate Depths

depth. It is difficult to countersink all the pieces alike without employing some method of this kind, especially if some of the pieces are thicker than others, but this is successfully accomplished with the tool described.

Ambridge, Pa.

COUNTERSINK SLEEVE

The sleeve here shown enables the user to obtain accurate depths in countersinking; where a large quantity of work is to be machined to the same depth, it saves time and produces satisfactory results. The sleeve A is made to fit the countersink and may be adjusted to suit the piece being worked on. The tool is fed down until the sleeve touches the surface of the work, so that all the pieces are countersunk to the same

AUGUST J. LEJEUNE

FALSE GRAPHIC REPRESENTATION

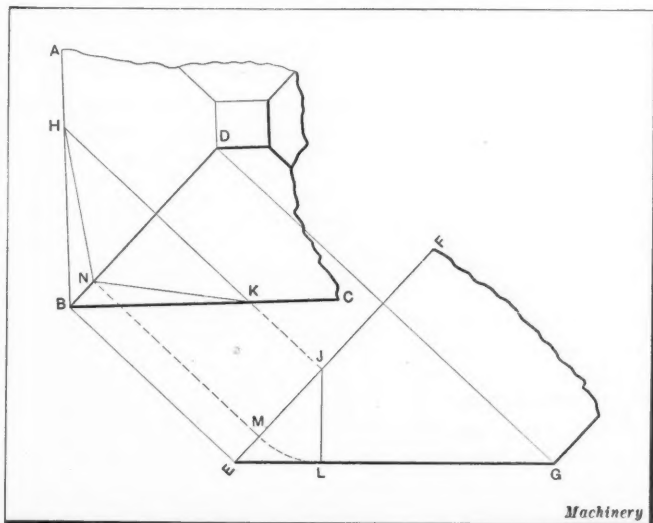
I find Babson's "Graphic Representations of Volumes and Weights" to be misleading. For eight times the quantity, he shows a bottle, bag, or barrel eight times as high and wide; whereas it should be only twice the linear dimensions, because $8 = 2 \times 2 \times 2$. This method was carried to the height of ridiculousness in the war statistics of the National Security League and American Defense Society, where armies were represented by soldiers of height in proportion to number. Nothing is so simple and convincing as ordinary heavy straight lines to scale.

New York City

ROBERT GRIMSHAW

FINDING TRUE ANGLE OF VALLEY PLATES FOR STEEL HOPPERS

The article in the May number of MACHINERY, "Laying Out a Hopper Miter Joint," brings to mind a method the writer has used to find the true angle of valley plates used on steel hoppers. It is a graphic method and may be used for any size or shape of hopper. Let ABCD represent the plan of the hopper, while EFG is the elevation; BD is the intersection line of the sides. Draw HK perpendicular to BD; line HK is the edge of an imaginary plane passed perpendicular to the intersection line and is shown in the elevation by a line JL drawn



Graphic Method of finding True Angle of Valley Plates for Steel Hoppers

perpendicular to EG. Revolve JL about the point J to the position JM and project the point M back to the plan to N. Then HNK is the true angle of intersection of the two sides of the hopper, since it is the trace on a perpendicular plane of the two sides after the plane is revolved into the plane of the drawing.

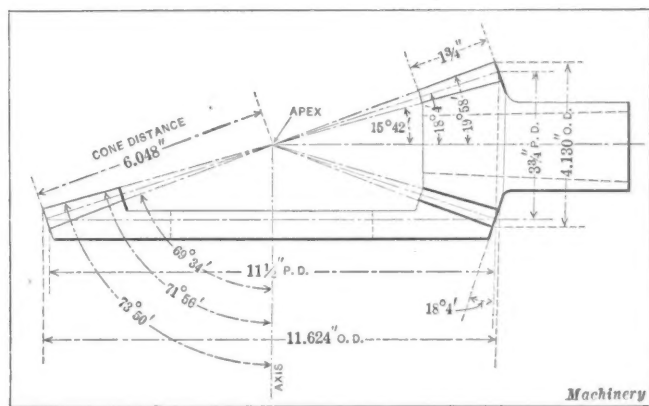
St. Joseph, Mo.

L. M. HAMLET

STUB-TOOTH BEVEL GEARING

Stub-tooth bevel gears are now being used extensively by some automobile manufacturers instead of the standard-tooth bevel gears. By using a 20-degree pressure angle and shortening the height of the gear tooth, a stronger gear is obtained, which requires no under-cutting but which has better rolling contact. This type of tooth is therefore recommended for machinery requiring gearing that will withstand severe stresses. The method of calculating the parts of this gear is best shown by an example.

Let it be required to make a pair of stub-tooth bevel gears of 4/5 diametral pitch, with 46 teeth in the gear, 15 teeth in the pinion, and a 20-degree pressure angle. As the tangent of the pitch angle of the pinion is $15 \div 46 = 0.32609$, the angle is 18 degrees, 4 minutes. The pitch angle of the gear is then 90 degrees — 18 degrees, 4 minutes = 71 degrees, 56 minutes.



Stub-tooth Bevel Gears of Forty-six and Fifteen Teeth

The pitch diameter of the pinion is $15 \div 4 = 3.75$ inches, and of the gear, $46 \div 4 = 11.5$ inches. The addendum of both the gear and the pinion is 0.2 inch. The cone distance is one-half the pitch diameter of the gear divided by the sine of the pitch angle of the gear, or $11.5 \div 2 \div 0.9507 = 6.048$ inches. Then, dividing the addendum, 0.2 inch, by the cone distance, 6.048 inches, gives the tangent of the increment angle for both the gear and the pinion; or, $0.2 \div 6.048 = 0.033068$. This angle is therefore 1 degree, 54 minutes. The face angle of the gear is 71 degrees, 56 minutes + 1 degree, 54 minutes = 73 degrees, 50 minutes; and the face angle of the pinion is 18 degrees, 4 minutes + 1 degree, 54 minutes = 19 degrees, 58 minutes.

The dedendum for both the gear and the pinion is 0.25 inch. The tangent of the dedendum angle or the angle of decrement for both gears is therefore $0.25 \div 6.048 = 0.04133$; which is the tangent of 2 degrees, 22 minutes. The cutting angle of the gear is then 71 degrees, 56 minutes — 2 degrees, 22 minutes = 69 degrees, 34 minutes; and of the pinion, 18 degrees, 4 minutes — 2 degrees, 22 minutes = 15 degrees, 42 minutes. The diameter increment of the gear is the product of twice the addendum and the cosine of the pitch angle, or $2 \times 0.2 \times 0.31012 = 0.124$ inch. Adding this to the pitch diameter of the gear gives the outside diameter of the gear, or 11.5 inches + 0.124 inch = 11.624 inches. The diameter increment of the pinion is the product of twice the addendum and the cosine of the pitch angle, or $2 \times 0.2 \times 0.9507 = 0.38$. Adding this to the pitch diameter of the pinion gives the outside diameter, or 3.75 inches + 0.38 inch = 4.13 inches. As the addendum is 0.2 inch and the dedendum is 0.25 inch, the total depth of the gear tooth is 0.45 inch. The thickness of the tooth is 0.3926 inch.

Brooklyn, N. Y.

EDWARD J. RANTSCH



Fig. 1. Piece formed by Die shown in Fig. 2

DIE FOR PRODUCING SMALL STEEL PIECES IN ONE OPERATION

Fig. 1 shows a small piece made from 1/32-inch steel, and Fig. 2 shows the die for producing it in one operation. Similar dies can be used for work of this kind, where great accuracy is not required, where the metal is light, and where the bending point is reduced, so that it is not necessary for the forming punch to bottom the piece against the die to form the bend. As the part is pushed through the die out of the way, the operation is much faster than it would be if the part were left on the die to be slid or knocked off.

Fig. 2 shows the plan of the die without the stripper and the front view of the punch and die. The hole is pierced at A and the piece formed, cut off, and dropped through at B. D and E are the cutting edges and F the forming edge, which is 3/16 inch higher than the cutting edges. The end of stop C is the same size and shape as the cutting-off punch, so that the end of the strip, after being cut, centers against it. The stripper G is 1/4 inch thick and extends 3/8 inch above the die, leaving 3/16 inch under it, over the forming edge. The cutting-off and

bend is completed before the piece is cut off. The forming edge is under-cut so that the piece is free to drop away from the punch and will not follow it back.

Plymouth, Mich.

W. B. GREENLEAF

A SIMPLE JIG

The toolmaker in the jobbing shop meets many difficulties; sometimes he is called upon to be a designer, without making elaborate details. The other day it was necessary to make three brass plates containing 280 steel pins, 3/32 inch in diameter, 1/2 inch apart. For one plate the holes for the pins were laid out by the aid of a milling machine, as accuracy was essential. But this method was too slow and not accurate enough. So four rows of holes were laid out on a piece of steel 3/16 by 6 by 3 inches, which was used as a jig.

As the brass plates were milled up square, it was easy to clamp the jig for the first four rows of holes. Then, after these holes were drilled, the jig was unclamped and moved along on the plate, being located by pins that passed through the jig into two of the holes drilled in the brass plate. This method was continued until all the holes were drilled. The plate laid out by the milling machine was not nearly so true as those laid out by means of the jig; this may be due to the fact that when milling machines are used much the screws

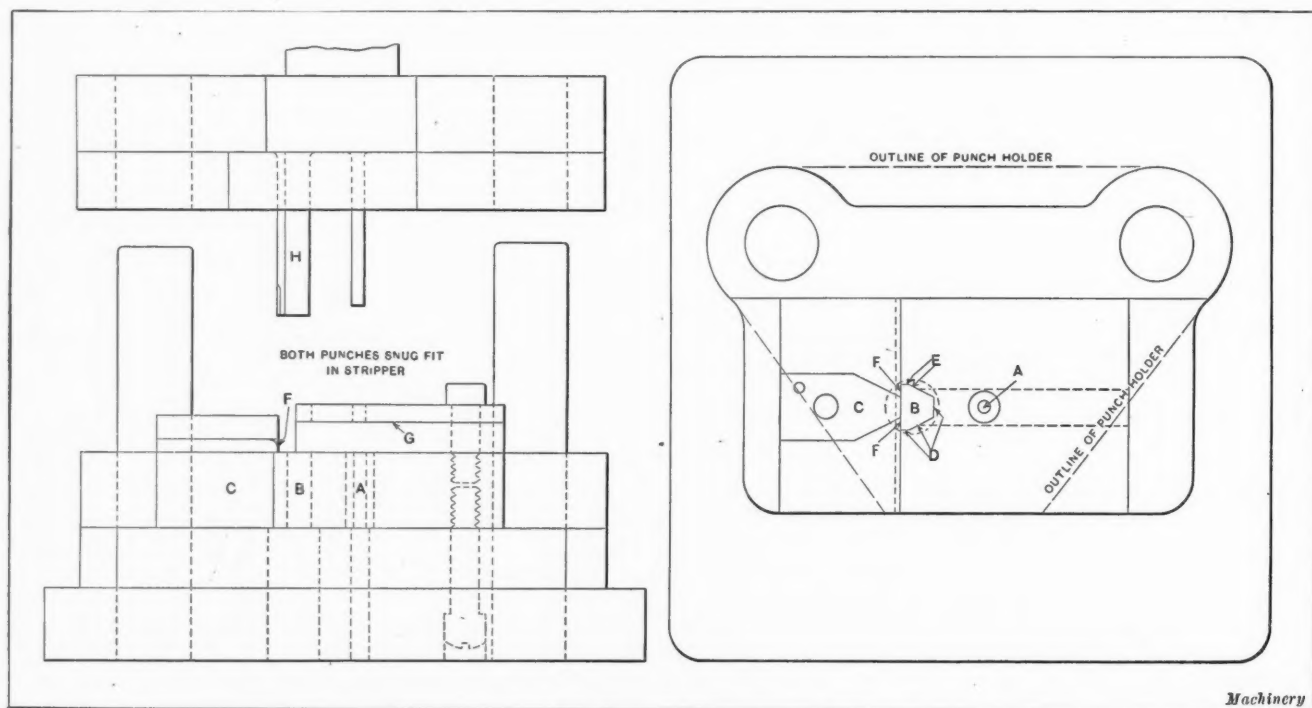


Fig. 2. Die for forming Small Steel Piece shown in Fig. 1

forming punch H is made the full size of the hole, except at the two corners where clearance is allowed for the two prongs. This leaves a space between the prongs for it to slide against the forming edge, to back up the cut. The guide pins are of one-inch drill rod; they are not hardened and are left with the original finish. They are a drive fit in the shoe and a nice sliding fit in the punch-holder, and have no bushings. This construction will outlast two or three dies and has been used for the last five years.

In operation, the strip is fed directly against the stop C; this gives a blank without prongs or hole. The second blank also lacks the hole, but after this blank a complete piece is produced at each stroke. If this material is bought in coils, the loss of two pieces at the beginning of each coil does not amount to anything. The press may be run continuously to the end of the coil, for the stop is positive and cannot be run over and the part drops through without scrap. As the punches rise after the cut, they carry the strip against the stripper, so that it is pushed forward on that level, with the prongs at the end resting on the forming edge. On the downward stroke, the punch bends the prongs while the blank is still part of the strip, which gives the prongs the necessary support, for the

wear and the graduated collars are not absolutely accurate. New Haven, Conn.

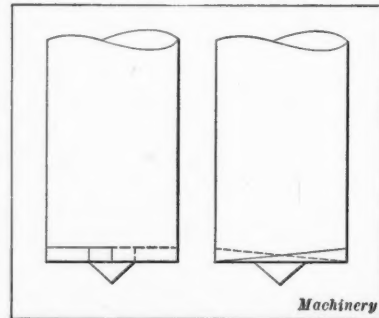
ERIC LEE

HEAVY-DUTY PUNCH

If a heavy-duty punch is ground off as illustrated, it will take less power to operate, start more easily, and shear a smoother hole than it will if ground as shown in the April number of MACHINERY.

I have used punches ground as illustrated up to two inches in diameter on material two inches thick, and have found that if the bevel is not greater than 3/32 inch in two inches, the punches stand up to the work and give better service.

C. G. WILLIAMS
Miles City, Mont.



Heavy-duty Punch

TO PREVENT BREAKING VULCANITE-MOUNTED MAGNIFYING GLASSES

A simple and effective method of preventing the breaking of the ferrule of vulcanite-mounted magnifying glasses consists of placing several rubber bands, about $\frac{1}{4}$ -inch wide, around the ferrule at the glass end, allowing the rubber to project slightly beyond the ferrule. When dropped, the glass end, which is the heavier, will almost always strike the floor first, and if not protected, the vulcanite, being very thin at this end, will chip off and allow the glass to fall out. These bands act as a cushion and protect the vulcanite.

Providence, R. I.

R. C. SCHOLZ

SAFETY ATTACHMENT FOR LADDERS

Several accidents occurred in the plant in which the writer is employed to the men who inspected, repaired, and oiled the lineshafting, before it was noticed that these were due chiefly to the fact that the ladders slipped when the men leaned too far to one side to reach a bearing, etc. Therefore, to prevent the ladder slipping along the shaft on which it was resting, rubber strips were tacked along both sides of the ladder, as indicated by the heavy lines in the accompanying illustration. This device worked out very satisfactorily, and no further accidents have been due to this source. Although not shown, the base of the ladder was also equipped with iron claws to prevent slip-page at that point.

Philadelphia, Pa.

W. A. LAILER

HARDENING KINK

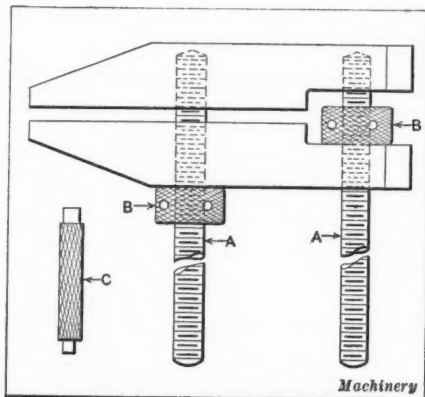
Toolmakers and diemakers often experience difficulty from dies expanding during hardening. If, when a die is put in the furnace, it is placed top face down on a firebrick slab, it will get more heat than if placed bottom face down, which is the usual method. The hole will then contract, instead of expanding, and will allow about 0.002 inch for stoning. When too much metal has been filed from the hole in the die, there is more chance of the templet fitting if the die is hardened this way.

Long Island City, N. Y.

E. KERN

TOOLMAKER'S CLAMP

The clamp shown in the accompanying illustration is one of the most useful to be found. As the screws A are headless and pass through only one side, it is possible to get to the bottom working surface. The nuts B permit the work to be fastened more securely than the screws



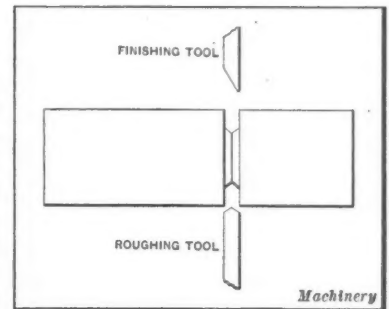
Handy Parallel Clamp for Toolmakers and Diemakers

in the ordinary form of clamp; the nuts are tightened by means of the pin C. This clamp is made of cold-rolled steel and is casehardened; the nuts are made of carbon steel and are drawn to a dark brown, and the screws are made of steel (Stubs gage) and tempered in oil.

AUGUST J. LEJEUNE
Ambridge, Pa.

CUTTING-OFF TOOLS

The accompanying illustration shows two cutting-off tools mounted on one cross-slide. With a roughing tool shaped as shown, greater speed and better work is insured, and a minimum of power is required. This tool is self-clearing on the sides



Roughing and Finishing Cutting-off Tools

and guides straight, an important feature when cutting off thin disks of large diameter. When the roughing tool has been fed to a certain point, it is backed off and the finishing tool on the opposite side is brought up to finish the cut. The small amount of work done by the finishing tool makes it possible for this tool to be ground at an extreme angle, thereby making a clean cut.

Oak Park, Ill.

P. BERTLES

GRINDING EDGE TOOLS ON EMERY WHEEL

The article entitled "Wheel Dressing" in the June number of MACHINERY recalls an incident that shows what the average wood-worker thinks of the emery wheel for grinding edge tools. The writer was assisting the boss patternmaker to make a large pattern, which was being turned in the lathe, when it became necessary to grind the wood-turning chisel. This was made from a flat file 5/16 by 1 1/2 inch, and considerable stock had to be removed to put the chisel in good working condition. As the shop grindstone was worn down pretty close to the hub, the writer began to grind the chisel on the emery wheel, but was soon stopped by the boss, who called him down for committing such an unmechanical act.

In that particular shop the grinding of an edge tool on an emery wheel might be considered unmechanical, but the writer did it long before he worked there and has done it ever since, and his edge tools are in good condition and in use every day. A great many first-class mechanics in the wood-working lines have an idea that the emery wheel has a bad effect on edge tools. Perhaps experiences have shown this to be

true, but if you inquire from these men, "Do you keep the wheel in good cutting condition?" their answer is in a great many instances, "I never bother about that; an emery wheel requires no attention."

Wood-turning tools become dull very quickly; they are made from heavy stock, and grinding, even on a good grindstone, is slow and tedious. In a great many shops, the grindstone is located in a dark corner some distance from the wood-turning lathes, and during the process of turning a great many patterns, several trips to the stone must be made. The writer grinds his turning tools on an emery wheel, which he has mounted on a wooden faceplate that fits on either end of the lathe spindle. When turning between centers or on a faceplate at the front end of the lathe, the emery wheel is mounted at the back end of the spindle, and when turning at the back end of the spindle, the emery wheel is placed at the front. For the small lathe, a small wheel is mounted on a wooden center made like the regular lathe center and fitted to the hole in the spindle. By this plan, the turning tools are easily and quickly ground without leaving the lathe. All inside-ground gouges are ground on the small wheel, as it is but a moment's

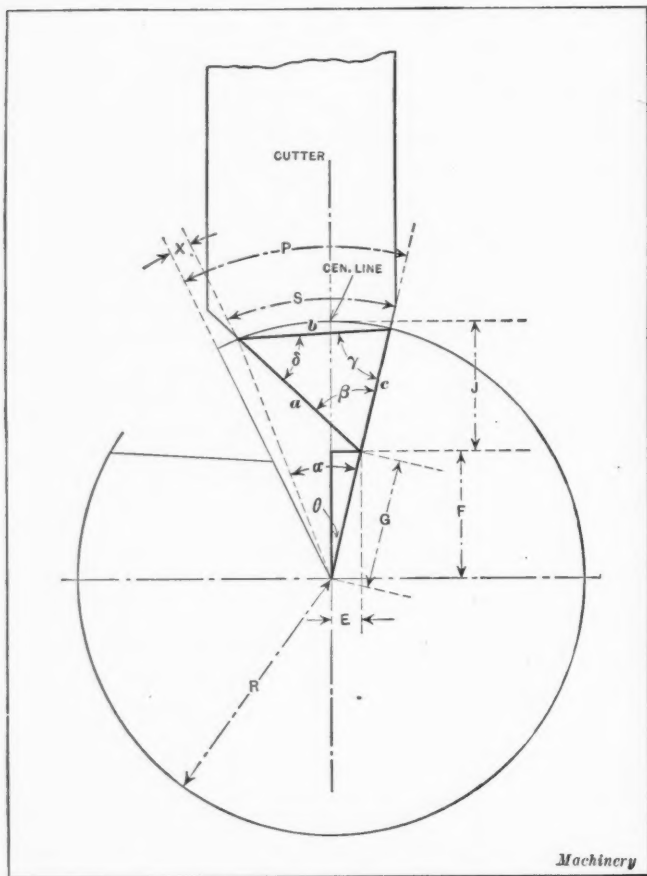


Diagram for finding Set-over, Depth, etc., of Cutter

work, with the aid of the dresser, to form the wheel to the curve of the gouge. The wheels and the dresser are part of the writer's turning-tool kit; they are his own property and he keeps them in good cutting condition. A clean wheel will do good and fast work; a dirty, glazed, neglected wheel will not grind burrs off rough castings, to say nothing of edge tools.

Kenosha, Wis.

M. E. DUGGAN

SETTING AN ANGULAR CUTTER FOR MILLING SPIRALS

The writer recently had a number of spiral end-mills to flute, and not being able to find a suitable formula for obtaining the necessary set-over, full depth, etc., used the solution given herewith. The outside diameter, number of teeth, and width of land are the dimensions furnished. In this solution it is assumed that the vertex of the cutter angles is a point, N = number of teeth; X = land; R = radius. The cutter

angles were 53 and 12 degrees. Arc $P = \frac{2R\pi}{N}$; arc $S = P - X$;
 $\alpha = \frac{360 \text{ degrees}}{2R\pi}$; $\gamma = \frac{180 \text{ degrees} - \alpha}{2}$; $\beta = 65 \text{ degrees}$; $\delta = 180$

degrees — $(\gamma + \beta)$; $b = 2R \times \sin \frac{\alpha}{2}$; $c = \frac{b \times \sin \delta}{\sin \beta}$; $G = R - c$;
 $\theta = 12 \text{ degrees}$; $E = G \times \sin \theta = \text{set-over}$; $F = G \times \cos \theta$;
 $J = R - F = \text{full depth}$.
 Denver, Colo.

STANLEY EDWARDS

LIGHTING STAIRCASES

Recently, the writer called attention, in a certain factory, to the necessity of having electric lights at the foot of each staircase. Light at the top of the flight casts a shadow on each step and makes the stairs dangerous. He also found a swinging door opening outward at the foot of one of the stairs, tending to block the corner on the turning. Such a door should not be used as a fire

exit, unless it can be locked back when open, and it is a poor arrangement in any case.

New York City

ROBERT GRIMSHAW

DOUBLE KEYWAY MILLING FIXTURE

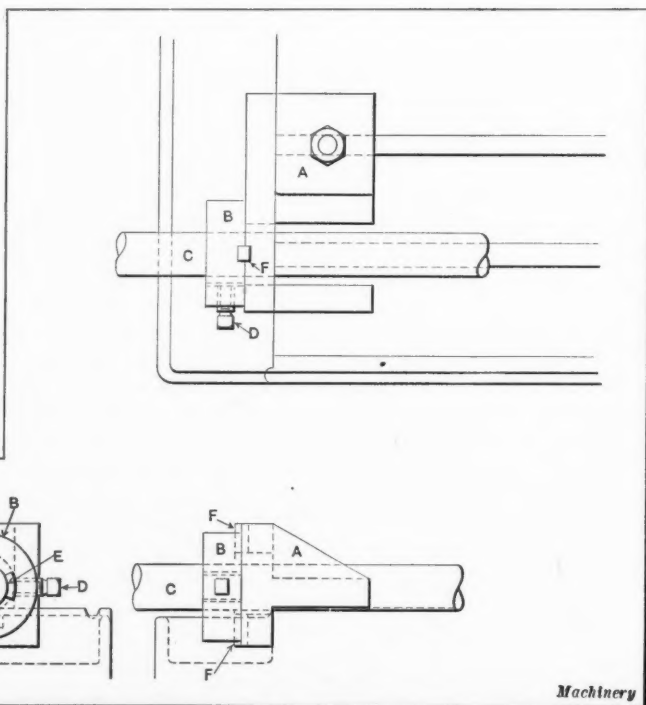
The accompanying illustration shows an indexing fixture that was designed for milling opposite keyways for movable saws in long saw arbors on wood-working machinery. The keyways are cut in opposite sides in order to balance the shafts, as they run at high speed. The fixture consists of a cast-iron bracket A and a steel collar B which is fastened to the shaft C to be milled, by a set-screw D that bears on a shoe E . The bracket A extends down over the end of the platen of the milling machine and is held in place by a bolt in the T-slot next to that in which the work is laid. The collar B thus forms a stop, bearing against the bracket and the end of the platen to resist the action of the milling cutter. The collar is slotted to receive two keys F , which are fastened in slots in the body A of the fixture; the slots in the collar are made central with the hole. No key is used to locate the fixture in relation to the T-slots, as this would entail locating the key an exact distance from the indexing keys, and this would be affected by any variation in the chamfer on the edges of the T-slot where the work is located.

In operation, the work and fixture are put on the milling-machine table, and the holding-down bolt is tightened slightly by hand; the hole for this bolt is 1/16 inch larger than the bolt. Collar B is then set up solidly on the shaft in the proper position lengthwise, and the shaft is strapped down over the T-slot with U-straps in the customary manner. The holding-down bolt for the fixture is now tightened, as the work has located it in the correct position. When the slot has been milled, the U-straps are loosened, the shaft is drawn back until collar B clears keys F (without loosening the collar), the shaft is given a half turn, and the collar is slipped over the keys again. The straps are then tightened and the second slot is milled.

This fixture has done very satisfactory work, indexing the slots perfectly without the necessity of putting the shafts on index centers, which in most cases would be impossible owing to the length of the shafts handled. The accuracy of the fixture is dependent wholly on the accuracy with which the slot in collar B is centered; this can easily be done very accurately. The fixture is so proportioned as to handle shafts from 1 7/16 to 2 3/16 inches in diameter, a collar being used for each size of shaft that is milled.

Orange, Mass.

W. R. STULTS



Indexing Fixture for milling Double Keyways in Shafts

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

HOBBS AND MULTI-CUTTERS

A. L. K.—We have had a difference of opinion over the meaning of the term "hob." What is the correct definition?

A.—The term hob, when applied to a tool for cutting threads or gear teeth, means a cutter having teeth in a helical path like a tap. The term hob is sometimes erroneously applied to multi-cutters used in thread milling machines for cutting threads. These cutters do not have the teeth in a helix, but in parallel circumferential rows.

MARKING COUNTERSINK ANGLES ON DRAWINGS

H. G. F.—We have had a lengthy discussion on the proper method of marking the angle of countersinks on a drawing. I made a drawing which indicated three holes for screws with countersink heads, and marked them "25/64 drill, 76 degrees countersink." When the pieces were made and delivered, it was found that the included angle of the countersink was 104 degrees, that is, 180 degrees minus 76 degrees. Will you kindly tell us what is regarded as the proper method of marking countersink angles?

A.—The angle of countersink is always the included angle and there is no practice warranting anyone using the supplement angle instead. The angles of twist drills, countersinks, and similar tools, are always expressed as the included angle or half the included angle.

WHY DIDN'T IT EXPLODE?

W. S. R.—A small can of evaporated milk—not the thickened condensed milk, but the 50 per cent reduction kind—was left in a pot of water boiling furiously for twenty minutes after it came to a boil from 96 degrees F. The can was absolutely tight and there was no apparent escape of steam. Early in the boiling the can ends bulged, indicating internal pressure, but that was all. Why didn't it explode?

A.—The probability is that the ends bulged sufficiently to crack the soldering at some point and make a minute opening through which sufficient steam escaped to prevent explosion. However, there is another side to the matter, and that is the slowness of heat transfer under certain conditions. It may be that even after having been in boiling water for twenty minutes, the whole mass of milk had not yet reached boiling temperature. The question is submitted to the readers.

GRINDING TAPER PLUGS IN BRASS VALVES

F. E. R.—What is an approved method of grinding in the taper plugs of brass plug cocks? I have had trouble in making a tight job, using fine ground glass and flour emery as abrasives.

A.—The grinding in of brass taper plugs in valve bodies is a job requiring considerable care and skill to insure watertightness. Emery should never be used, as it tends to cut circumferential grooves, and the abrasive action continues after the valve is put in use, due to minute particles of emery that are left embedded in the soft brass. Valve manufacturers use fine burnt foundry sand mixed with machine oil to form a paste abrasive for grinding plug valves. Hard soap is rubbed on the plug at short intervals to furnish the necessary lubrication. The action when grinding in a plug valve should be an oscillating motion, and the plug should be pulled out of the valve body frequently to distribute the abrasive evenly and to prevent cutting. The fine burnt sand and hard soap give good results; when the grinding is finished, the surface may be easily cleaned and no cutting will take place afterward.

CASTING LAMP BASES AND COFFIN HANDLES WITHOUT CORES

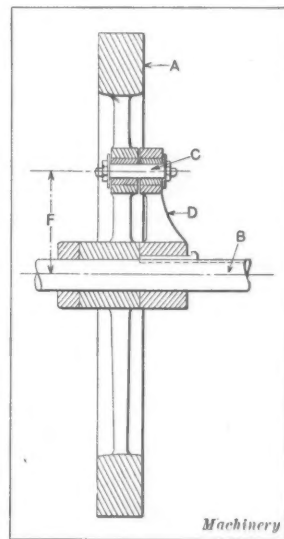
H. T. S.—Will you tell me how fancy lamp bases, coffin handles and other articles requiring a high finish are cast hollow without using cores?

A.—Fancy lamp bases are cast in iron molds by pouring in a comparatively small amount of alloy having a low melting point and turning the mold about while a thin shell of the metal hardens. When the desired thickness has hardened, the workman tilts the mold so that the molten metal runs out, leaving a thin shell of metal in the mold, which is then removed. Essentially the same process is employed in casting coffin handles. The mold is provided with a gooseneck into which the britannia metal is poured. The mold is allowed to stand for a few seconds until the metal hardens and then turned over and the molten metal poured out, leaving the center hollow. The workman can make a thick or thin shell by simply varying the time that the metal is allowed to stand in the mold. Considerable skill is required to make a shell of uniform thickness, especially thin shells. The chief art in this trade is in securing uniform thickness of the shell and using the minimum of metal.

RESISTANCE OF SHEAR PIN

P. G. P.—We have fitted a flywheel with the safety device shown in the illustration. A one-inch square steel pin *C* is held between steel bushings, one bushing being held in the flywheel arm and the other in a spider *D* keyed to the shaft *B*. The flywheel *A* is free to revolve around the shaft, in case an overload should shear pin *C*. We have assumed that it would require 60,000 pounds to shear a steel pin one inch square and also that the pin would be severed when sheared about one-third its thickness. The question is, does the distance *F* affect the resistance of the shear pin? It seems to me that it must remain the same wherever placed.

A.—The position of the shear pin positively affects its effective shearing resistance. If it is located at the hub, its resistance to the action of the flywheel will be much less effective than if it is located in the rim. If the shear pin is located 20 inches from the shaft center, its effective resistance to check the flywheel will be twice that if placed only 10 inches from the center. The principle is exactly the same as found in a pair of shears. If a thick wire is to be sheared, you place it as near the pivot or hinge of the shears as possible in order to get the most effective leverage. The farther the wire is placed from the pivot, the harder it is to force the jaws through it. The wire cuts no harder, however, in one position than in the other, but the effective leverage is lessened as the wire is moved away from the pivot.



Flywheel loosely mounted on Shaft and driven by Shear-pin

MELTING COPPER IN AN IRON CUPOLA

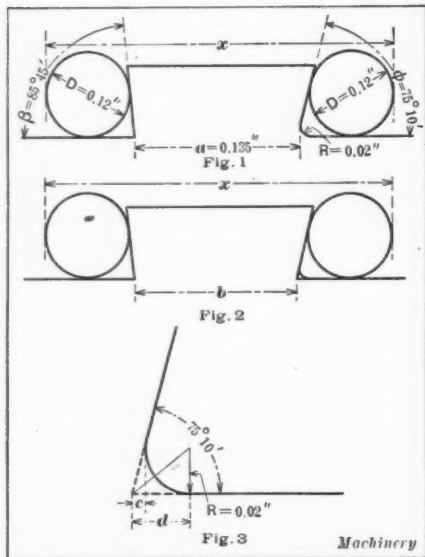
E. P. F. & N. Co.—We have a small brass furnace and an iron cupola in our foundry and have to make three bronze castings weighing one ton each. We understand that the copper can be melted in the iron cupola and the tin, zinc and lead required for making brass or bronze mixtures may be melted in the brass furnace and heated in the cupola as the copper runs from the iron cupola. Will you please advise?

A.—Large quantities of copper for making bronze castings may be melted in an iron cupola by using a reduced tuyere area and a blast pressure of 8 to 10 ounces. The tin and other metals used for making the bronze should be melted in an ordinary crucible brass furnace and poured into a large ladle into which the copper is tapped from the cupola. Care

should be exercised in melting the copper to use a fuel having a low sulphur content. After tapping the cupola, the melted copper should be covered with lump charcoal to prevent oxidation. Heavy brass castings may also be made by melting in an iron cupola. The practice of Dibert, Bancroft & Ross Co., Ltd., of New Orleans, Pa., in melting brass in the cupola, is to charge with 90 per cent heavy red brass and 10 per cent pure copper. A very light blast is used while melting. The losses from oxidation in the foregoing mixture vary according to the quality of brass with which the cupola is charged, but are rarely more than 5 per cent, affecting mostly the zinc and tin. To secure the proportions desired in the casting, zinc and tin, previously melted in a brass furnace, are added to the ladle after tapping from the cupola. The company has not thought it necessary to use deoxidizers in the ladle, although they are regarded as beneficial in some cases.

MEASURING DOVETAIL SLIDES

S. C. B.—Please show me how to calculate the distance over the two wires used in measuring the dovetailed angles shown in Fig. 1, the dimensions of which are as given.



Figs. 1 to 3. Diagrams used for finding Distance x

Distance x is then found by the formula $x = D + \left(\frac{1}{2} D \times \cot \frac{\beta}{2} \right) + \left(\frac{1}{2} D \times \cot \frac{\phi}{2} \right) + b$. Applying these formulas to the present case, $d = 0.02 \times \cot \frac{75 \text{ deg., } 10 \text{ min.}}{2} = 0.02598$ inch; so $c = d - R = 0.02598 - 0.02 = 0.00598$ inch, and $b = a - c = 0.135 - 0.00598 = 0.12902$ inch. Then $x = 0.12 + 0.06 \times 1.0774 + 0.06 \times 1.2993 + 0.12902 = 0.3916$ inch.

MEASURING FORCE OF A HAMMER BLOW

C. C. B.—To test the force of a blow in hammers, we take a round lead plug, one inch in diameter and one inch high, and strike it one blow with the hammer; then we take a duplicate plug, put it in a Riehle testing machine, and press this plug to the thickness of the plug that has been struck. Is the pressure indicated by the machine equal to the force of the blow? Some people say it is, while others take the opposite view; which are right?

A.—The fundamental formula for ascertaining the force of a blow is $ft = mv$, in which f = force of blow, t = time required to bring body to rest, m = mass of body, and v = velocity of body at instant of striking. It is seldom possible to measure t and it is usually difficult to ascertain v ; consequently it is customary to determine the force of a blow, with more or less accuracy, by employing the principle of work. In the case of a pile driver, this method gives fairly satisfactory results, the formula being, theoretically, $wh = fs$, in which w = weight of falling body, h = height of fall, f = force

of blow = resistance offered by pile, and s = distance pile is driven by blow; the weight w and the force f are in pounds and h and s are in feet. In the present case, the hammer is assisted by an additional force, and if this is known or can be found, it must be added to w . Even then, the result will not be exact, because every body, even lead, has a certain amount of elasticity and will not entirely retain the shape it had at the instant of greatest compression. Solving the foregoing

formula for f , $f = \frac{wh}{s}$. If it is assumed that the work done

in the testing machine is equal to wh , all that is necessary is to multiply and divide the pressure p recorded by the machine by s (measured in feet), and the result ($f = p$) will be a fair approximation to the force of the blow struck by the hammer. But this assumption implies that the pressure is uniform from the instant that the plug begins to be compressed until the required thickness is reached, which is by no means the case. It is also probable that a greater force will be required in the machine than the almost instantaneous force exerted by the hammer; however, it is reasonable to assume that your method is not far wrong. J. J.

CONCERNING THE DIAMETER OF A SHAFT

B. C. L.—In an article showing how to calculate the diameter of a steel shaft, I find the statement: "If the diameter is less than 13.6 inches, use Formula (1); but if it is greater than 13.6 inches, use Formula (2)." The formulas are as follows, in which d is the diameter, in inches, H is the horsepower transmitted, and N is number of revolutions per min-

ute: $d = 4.7 \sqrt[4]{\frac{H}{N}}$ (1), and $d = 3.3 \sqrt[3]{\frac{H}{N}}$ (2). Why are the

formulas so different, and how is the number 13.6 obtained?

A.—When a shaft transmits power, it is subjected to a twisting stress, and the resulting deflection is measured by the so-called "angle of twist." It is not desirable to have this angle exceed a certain limit, and when it is taken into account, Formula (1) is derived. But when the angle of twist is neglected and only the strength of the shaft is considered, Formula (2) is obtained. It is evident that there must be one diameter for which both formulas will give the same result; to find it, proceed as follows: Placing the right-hand members of the

two equations equal to each other, $4.7 \left(\frac{H}{N} \right)^{\frac{1}{4}} = 3.3 \left(\frac{H}{N} \right)^{\frac{1}{3}}$, or $4.7 \left(\frac{H}{N} \right)^{\frac{1}{12}} = 3.3 \left(\frac{H}{N} \right)^{\frac{1}{12}}$. From the last expression, ob-

tain by division $\left(\frac{H}{N} \right)^{\frac{1}{12}} = \frac{4.7}{3.3}$. Raising both members to

the 12th power, $\frac{H}{N} = \left(\frac{4.7}{3.3} \right)^{12} = 69.675$, using a five-place

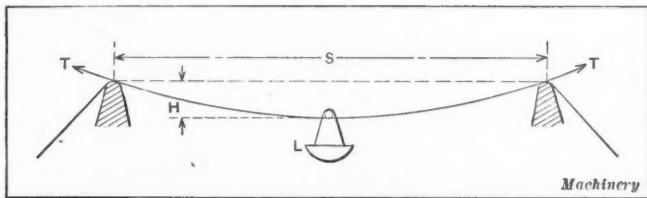
table of logarithms. Substituting this value of $\frac{H}{N}$ in either

of the two formulas, the value of d is found to be 13.579, say 13.6. In practice, that formula should be used which gives the larger value for d . If the diameter is less than 13.6, Formula (1) will give the larger value; but if the diameter is greater than 13.6, Formula (2) will give the larger value. In the case of engine crankshafts, neither formula will give very good results, because the heavy loads induce bending stresses, which must also be considered, the resulting formula being somewhat complicated. J. J.

STRENGTH OF ROPE FOR A CABLE BRIDGE

W. H. D.—We wish to put a cable bridge across a small stream and would like to know what size steel-wire rope, nineteen wires to the strand, will be necessary. The span is 85 feet, and the sag H must not exceed 5 feet; the greatest weight of the car and contents is 2500 pounds.

A.—As may be supposed, it is not possible to derive a formula that will give exact results; that is, results that will be closer than, at the most, two significant figures. The ten-



Determination of Strength of Rope for a Cable Bridge

sion T in the rope may be found quite accurately by means of the following formula:

$$T = L \left(\frac{S}{4H} + \frac{4HL}{S^2W + 2SL} \right) + \frac{S^2W}{8H} + HW$$

in which S = span, in feet;

H = sag, in feet;

L = maximum weight of car and contents, in pounds;

W = weight of rope, in pounds, per foot of length.

In order to find a value for T , it is necessary first to determine the value of W . When the values of S and L are comparatively large, as in this case, and steel rope is used, W exerts but a small effect on T ; hence, making $W = 0$, a value for T is found, by means of which the size of the rope can be determined, approximately. In the present case,

$$T = 2500 \times \left(\frac{85}{4 \times 5} + \frac{4 \times 5 \times 2500}{2 \times 85 \times 2500} \right) = 10,900 \text{ pounds, approximately.}$$

It is necessary to allow a reasonable factor of safety, the value of which will depend upon how frequently the cable is used and how often the maximum load is carried; it may be as low as 3 or as high as 6. Assuming that it is 4.5, the rope should have a breaking strength of $10,900 \times 4.5 = 49,050$ pounds, say 25 tons. A cast-steel wire rope $\frac{3}{8}$ inch in diameter has a breaking strength of 25 tons and weighs 1.2 pound per foot. Substituting this value for W in the complete formula for T ,

$$T = 2500 \times \left(\frac{85}{4 \times 5} + \frac{4 \times 5 \times 2500}{85^2 \times 1.2 + 2 \times 85 \times 2500} \right) + \frac{85^2 \times 1.2}{8 \times 5} + 5 \times 1.2 = 11,135 \text{ pounds.}$$

Multiplying by the factor of safety, $11,135 \times 4.5 = 50,107$ pounds, or 25 tons, very nearly. Hence a $\frac{3}{8}$ -inch rope will be large enough; but if the cable bridge is to be subjected to heavy usage, it might be well to use a 1-inch rope.

J. J.

TRIGONOMETRIC FUNCTIONS FOR ANY ANGLE

J. P. C.—I should appreciate a rule that is easily remembered for finding the trigonometric functions for angles greater than 90 degrees, using an ordinary table.

A.—Let x be any angle less than 90 degrees; then any other angle can be expressed as $n \times 90$ degrees + x , n being an integer. For example, 286 degrees, 42 minutes may be written 3×90 degrees + 16 degrees, 42 minutes; 563 degrees, 19 minutes = 6×90 degrees + 23 degrees, 19 minutes; and 52 degrees, 24 minutes = 0×90 degrees + 52 degrees, 24 minutes. As shown in Fig. 1, angles are assumed to increase by the radius starting from OA and moving counter-clockwise about the circle; hence $AOM = x$, $AON = 90$ degrees + x , $AOP = 2 \times 90$ degrees + x , and $AOQ = 3 \times 90$ degrees + x . If the angle is greater than 360 degrees (= 4×90 degrees), subtract 4 (or some multiple of 4), so that n will be less than 4, but not negative. For example, the functions of 563 degrees = 6×90 degrees + 23 degrees are exactly the same as for 2×90 degrees + 23 degrees = 203 degrees. Having expressed the angle in the form $n \times 90$ degrees + x , note whether n is even or odd; if it is even (0, 2,

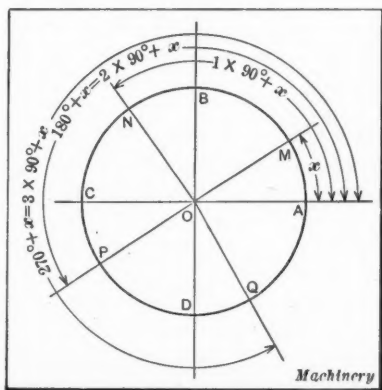


Fig. 1. Angle Diagram

4, etc.), the numerical values of the functions will be the same as those for x ; but if n is odd (1, 3, 5, etc.), the numerical value of the functions will be the same as those for the co-functions of x . Thus the numerical value of the sine of 203 degrees = 2×90 degrees + 23 degrees is sin 23 degrees; of 296 degrees = 3×90 degrees + 26 degrees is cos 26 degrees, cot 163 degrees = 1×90 degrees + 73 degrees = tan 73 degrees, etc. The sign of the function is determined by noting the quadrant in which the revolving radius stops. As shown in Fig. 2, all the functions are positive for the first quadrant AB . Note that for the upper semicircle ABC , the sine is positive and for the lower semicircle it is negative. For the right-hand semicircle BAD , the cosine is positive; and for the left-hand semicircle, it is negative. In the diagonally opposite quadrants AB and CD , the tangent and cotangent are positive, and in the other two diagonally opposite quadrants BC and DA , they are negative. From this it follows that cos 685 degrees, 13 minutes, 33 seconds = cos 7×90 degrees + 55 degrees, 13 minutes, 33 seconds = cos 3×90 degrees + 55 degrees, 13 minutes, 33 seconds = + sin 55 degrees, 13 minutes, 33 seconds.

The name of the function changes from the cosine to the sine because n is odd; the sign is plus because the revolving radius stops between D and A in the fourth quadrant, and the cosine of any angle in this quadrant is +. The sign of the secant is the same as that of the cosine of the same angle, since the secant is the reciprocal of the cosine; for the same reason, the sign of the cosecant is the same as that of the sine of the same angle.

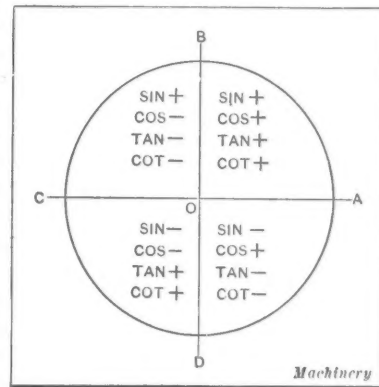


Fig. 2. Signs of Functions in Each Quadrant

J. J.

GANG AND MULTIPLE-SPINDLE DRILLING MACHINES

E. K. H.—What is the distinction between an upright multiple-spindle drilling machine and a gang drilling machine? It is my impression that a machine is classified as a multiple-spindle drilling machine if there are two or more spindles carried by a single frame, and that it is known as a gang drilling machine if there are two or more spindles carried by individual machine frames.

A.—This question was submitted to the principal makers of multiple-spindle and gang drilling machines, but there seems to be no general agreement. F. K. Hendrickson, of the Reed-Prentice Co., Worcester, Mass., writes: "Originally a gang drill meant not only a machine composed of a series of independent frames or columns carrying one or more spindles, but any type of machine wherein there were several spindles. I note that it is your impression that a multiple-spindle drill is composed of two or more spindles carried by a single machine frame and that a gang drill is composed of two or more spindles carried by individual frames. If your meaning of the word 'frame' applies to the entire column or unit, the distinction would be quite definite, but if your understanding of the word frame merely suggests the member carrying the spindle, the situation becomes a little more complicated. In referring to the old type of gang drills such as were originally used by the railroads, a main housing with cross-rail was a general construction upon which were mounted several heads, each carrying its own spindle or multiple spindles. This type of machine was generally known as a gang drill. It is my opinion that a multiple-spindle drilling machine is any drilling machine having a single housing, with all the spindles either mounted in a single head or in independent heads and supported by the single housing, while a gang drill is a series of practically independent machines driven from one source of power and mounted either on a single base or independently in a group."

G. E. Randles, vice-president of the Foote-Burt Co., Cleveland, Ohio, states that it is their opinion that any drilling machine having more than one spindle is a multiple drill, and from this the different types should be classified, such as: universally adjustable (which would be the Baush type); fixed center independent feed, the type of drilling machine in which the spindle heads are mounted on a common cross-rail and adjustable in a straight line for centers, but provided with an independent feed for each spindle. "The gang type is this same sort of machine, except where the feed is connected up in a gang and the feed on all spindles is engaged and disengaged at one time and from one point. We think this type of machine is more truly the gang drill than the type to which you refer where several individual machines may be set on one base with one common table, such as the Barnes type. We would say that the correct term for a battery of machines of this sort would be fixed by the size of the machine set in a gang, no matter what number may be used. We build practically all types of multiple-spindle drills and class everything of more than one spindle as a multiple drill, but also classify them beyond this as universally adjustable multiple drills, independent-feed multiple drills, gang-type multiple drills, etc."

G. E. Hallenbeck, of Baker Bros., Toledo, Ohio, writes that it is their belief that "multiple-spindle drill" should apply to machines of the Baush, Fox, "Natco" or cluster box type, and that "gang drill" should apply to single-spindle drilling machines connected in a gang.

TOGGLE FRICTION CLUTCH

H. W. L.—The two clutches shown roughly in Fig. 1 act on the toggle principle. What is the theory pertaining to the friction and forces acting on the bearing surfaces of such clutches? I have been unable to find any data of this kind.

Answered by John S. Myers, Philadelphia, Pa.

To illustrate the principle on which such clutches operate, refer to Fig. 2. Here, a block resting upon a smooth surface is acted upon by a force C . This surface reacts against the block with an equal force C_1 , neglecting the weight of the block. Now force C may be resolved into a component N acting normal to the surfaces and a component F acting parallel to the surfaces. The resistance offered by friction opposing motion in the direction of the arrow is fN , where f = coefficient of friction. If this resistance is greater than the component F , no sliding of the surfaces will result. As $F = N \tan \alpha$, if we do not desire sliding to occur, $N \tan \alpha$ must be less than fN , or $\tan \alpha$ must be less than the coefficient of friction f .

The same principle applies to the clutch problem, and the forces there acting are indicated by similar letters in Figs. 3, 4 and 5. The function of the spring A , Fig. 1, is simply to keep the friction surfaces in contact, and the forces due to it as well as to centrifugal effect, being small, may be neglected. For example, suppose that it is desired to develop a twisting moment of 6000 inch-pounds with a radius R of 10 inches and a coefficient of friction $f = 0.08$; what are the forces acting? The frictional component must be $F = 6000 \div 10 = 600$ pounds. Taking $\tan \alpha = 0.06$, allowing 0.02 less than f

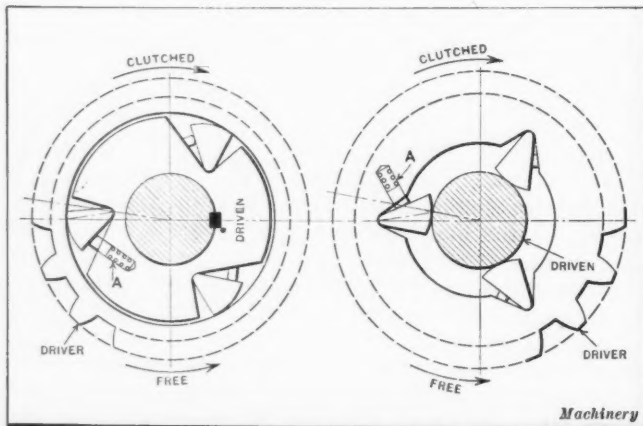
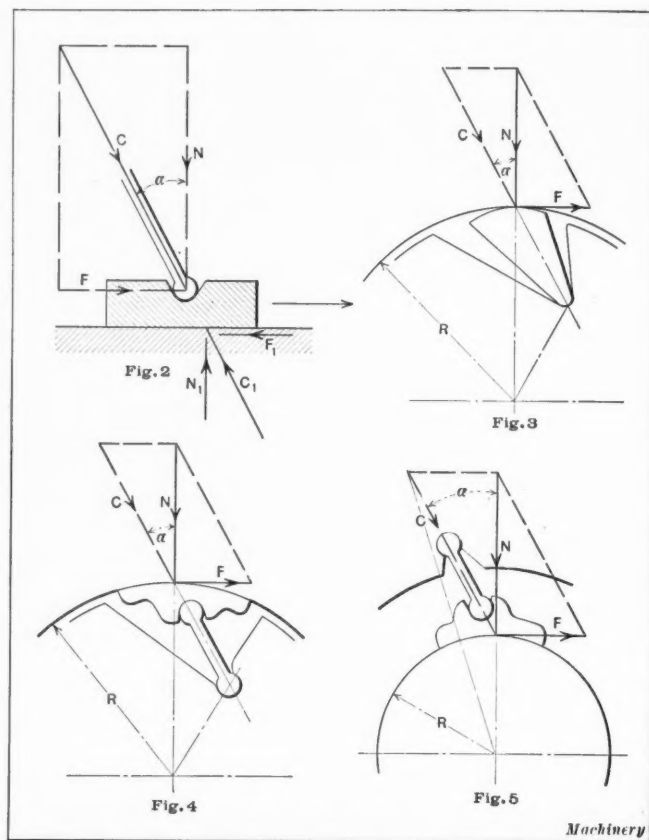


Fig. 1. Toggle Friction Clutches



Figs. 2 to 5. Diagrams showing Principles of Friction Clutches

as security against slipping, the force acting normal to the friction surfaces is $N = \frac{F}{\tan \alpha} = \frac{600}{0.06} = 10,000$ pounds, or

$10,000 \div 3 = 3333$ pounds on each of the three surfaces. The various parts of the clutch would have to be sufficiently strong to withstand these forces. Problems allied to this are discussed in "The Constructor," by Reuleaux, pages 158 to 161. The wearing shoes indicated in Figs. 4 and 5 make no difference in the theory of the device, but increase its useful life by preserving the proper length of the toggle element.

* * *

CONCRETE MIXTURES

In a paper read before the Concrete Institute of Great Britain recently, it was stated that in a 1-2-4 concrete the cement may range from 18 to 24 per cent of the total volume of the mixture. For instance, 130 tons of dry cement is required for a broken-stone aggregate and only 100 tons when gravel is used. But the concrete containing gravel is from 12 to 15 per cent weaker than the one with the broken stone. However, when the quantity of cement per cubic foot of the mixture is the same, gravel concrete is as strong as concrete with a broken-stone aggregate. Washing the aggregate increases the strength of hand-mixed concrete 30 to 40 per cent, and of machine-mixed concrete, from 15 to 20 per cent. As the strength of concrete is governed largely by the percentage of cement that it contains, it has been suggested that specifications, instead of calling for a 1-2-4 mixture, provide that the volume of dry cement used be a specified proportion of the total final volume of the mixture.

* * *

A new type of soldering iron consists essentially of two high-resistance heating points, or electrodes, that become incandescent when the current passes through them. As the circuit is closed as soon as the points come into contact with the metal to be heated, the iron is said to become heated to the required degree the moment it touches the work. Besides, the heat is generated at the point of contact and at the spot where the heat is needed when soldering, brazing, or annealing. The iron operates at from six to sixteen volts and the points are made to carry current according to ratings of 150, 250, and 500 watts.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

LEEDS & NORTHRUP OPTICAL PYROMETER

This is an optical pyrometer for determining temperatures by the comparison of luminous hot bodies with a tungsten lamp filament in the pyrometer, which is adjusted by means of a rheostat until the brightness of the lamp corresponds to the brightness of the heated part as seen through the pyrometer. The reading of a milli-ammeter connected to the pyrometer enables the observer to determine the temperature with considerable accuracy, the readings of different observers for temperatures within the hardening range of steel varying not more than six degrees.

For the measurement of temperatures above, say, 1400 degrees F., only two methods have been found practicable for works service. One of these is based on the thermo-couple and the other on the laws of radiation. The latter includes both the radiation pyrometer and the optical pyrometer, which utilizes only that radiant energy visible to the human eye. For many services the inexpensive base-metal couple may be used for accurate measurements up to 2000 degrees F. with satisfaction; the more fragile and expensive platinum couple may be used up to 2800 degrees F., but the thermo-couple, like thermometers in general, must assume the temperature of the hot object by convection, conduction, radiation, or all combined. This fact militates against its use for measuring the temperature of molten brass, iron and other metals, or for measuring temperatures in gas producers and other locations where the thermo-couple would be subjected to rough mechanical treatment or to contamination by vapors and gases, which would rapidly impair its accuracy. In many industries the temperatures are far above the range of thermo-couples.

Measurements by radiation can be carried out at a distance when the laws concerning the temperature of radiating body and intensity of radiation have once been determined, and the radiation receiving and measuring part need not be heated to the temperature of the radiating body, nor even anywhere nearly to that temperature. Pyrometers utilizing radiation are divided into two classes: those which measure as heat energy the total radiation falling upon the receiving part

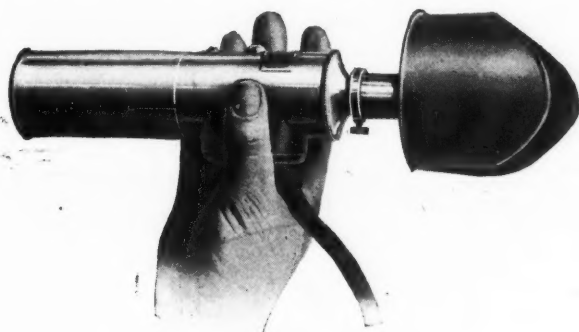


Fig. 1. Leeds & Northrup Optical Pyrometer

of the instrument, and those known as optical pyrometers, which are based upon the fact that the luminous radiation or light varies in a definite manner as the temperature of the hot body changes.

The greatest success has been attained by separating out one wave length of radiation—usually that which excites the sensation of red—and comparing the intensity of this one-color light with the intensity of the light of the same color emitted by a standard source of light. The eye is very sensitive when comparing the brightness of two surfaces when one is superimposed upon the other, and after having arranged to have light from the hot body and light from the standard of comparison viewed in this relation, they can be made equal, either

by varying the amount of light received from the incandescent object or by varying the intensity of the standard of comparison. The latter method, that is, variation of the intensity of the standard of comparison, is preferred and used by the U. S. Bureau of Standards, also by the Reichsanstalt, of Berlin, where its practical application has been brought to a high degree of perfection by Messrs. Holborn and Kuribbaum. The Leeds & Northrup Co., of Philadelphia, Pa., working under the

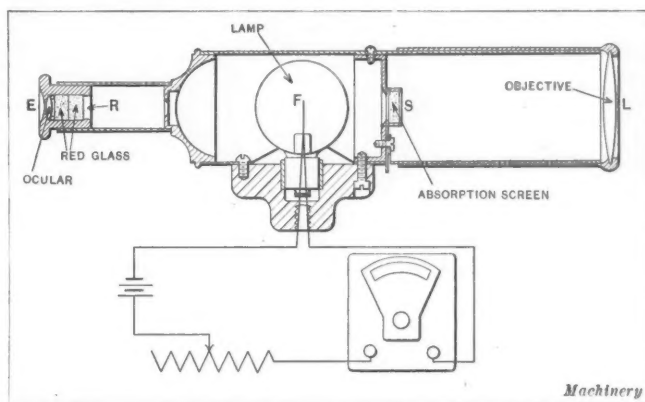


Fig. 2. Optical System and Electrical Circuit of Leeds & Northrup Pyrometer

fundamental Morse patents, has developed this type of optical pyrometer with a view to realizing a high degree of accuracy and reliability in a simple and portable device. The instrument, which is illustrated in Fig. 1, is suitable for measuring from dull red (about 1100 degrees F.) up to the highest known temperature.

The manner in which the luminous radiation from the hot body is balanced against that from a standardized source will be understood by reference to Fig. 2. By means of the lens *L*, rays from the hot body are brought to a focus in the plane *F*, where there is located a tungsten lamp filament. By means of the eye-piece *E*, the observer views the incandescent filament, which appears to lie upon the image, just as the cross-hairs in a surveyor's telescope appear upon the distant object looked at. By means of a rheostat in a case slung about the neck (see Fig. 3), the case also containing a storage battery and a milli-ammeter, the current through the lamp is adjusted until the brightness of the filament is just equal to the brightness of the image produced by the lens; that is, so that the filament blends with the background formed by the hot object. The observer then notes the reading of the milli-ammeter, which may be provided either with a special scale to read in degrees of temperature or the temperature corresponding to the current may be read from a calibration curve supplied with the instrument. The adjustment is made with accuracy, as the eye is keen in distinguishing differences in brightness between superimposed objects.

At high temperatures the light emitted by both the hot body and the filament would become dazzling, and comparison would be difficult. For this reason a red glass is placed in the eye-piece at *R*, which has the further advantage that light of only one color then reaches the eye and no difficulty is introduced by lack of color identity between the light emitted by the hot body and that emitted by the filament. The intensity of light radiation of any one color increases progressively in a definite manner as the temperature of the radiating body rises, and nothing is therefore lost by eliminating all other light from the comparison. As only brightness, not color, of light is matched, inability to distinguish colors and color-blindness do not interfere with the use of the instrument. In fact, in the range of temperatures used for harden-



Fig. 3. Method of using Optical Pyrometer

ing steel, for example, different observers using this instrument agree in their readings within 6 degrees F.

The brightness of the image of the hot body produced by the lens *L* is almost absolutely constant, irrespective of the distance from the hot body, although the size of the image varies with the distance. Since it is the brightness of the image and not the total radiation received through the lens that is measured, it is possible to measure the temperature of a small body or of a body at a distance equally as well as that of a large body or of one near at hand. It is not necessary that the hot body should fill the entire field of view of the instrument, as with "total radiation" pyrometers.

In observing bodies at very high temperatures, as 2500 degrees to 10,000 degrees F., the light received through the lens is too blinding for direct observation, even through the red glass of the eye-piece, and the intensity of the image might also become greater than that at which it is practicable to burn the tungsten filament, so that a balance would become impossible. Some method for reducing the intensity of the light must therefore be provided, such as by placing a screen to intercept some of the light. The screen is placed between the lens and the image so that it reduces the light from the hot body, but not that from the filament. With the reducing screen it is possible to make direct observations of the most brilliant light, as the electric arc or the surface of the sun.

It is not feasible to calibrate the instrument at such high temperatures by direct comparison, since they are above all known melting points and the ranges of contact thermometers, but fortunately a relation has been found to exist between temperature and intensity of radiation of any one color or wave length of light. By making use of this relation, known as Wien's law, and reducing the intensity of the image in a known ratio by means of the screen just referred to, it is possible to extend the scale of the instrument to the highest temperature. The scale thus obtained has been found to agree closely with a scale of temperatures established by known facts about the relation between temperature and total radiation. In other words, this form of optical pyrometer gives the same scale of temperature as do total energy pyrometers used with the precautions necessary to secure accuracy and precision in the measurement of total radiation. The screen used for cutting off part of the radiation from very hot bodies can be thrown into or out of the field of view by means of a milled disk projecting through an opening in the tube of the instrument. With the absorbing screen in use, a different milli-ammeter scale or calibration curve is required, but as the range of the instrument without the ab-

sorbing screen overlaps many hundred degrees with the range for the absorbing screen, the accuracy of the two scales can always be checked by observing a hot body, the temperature of which lies within this range.

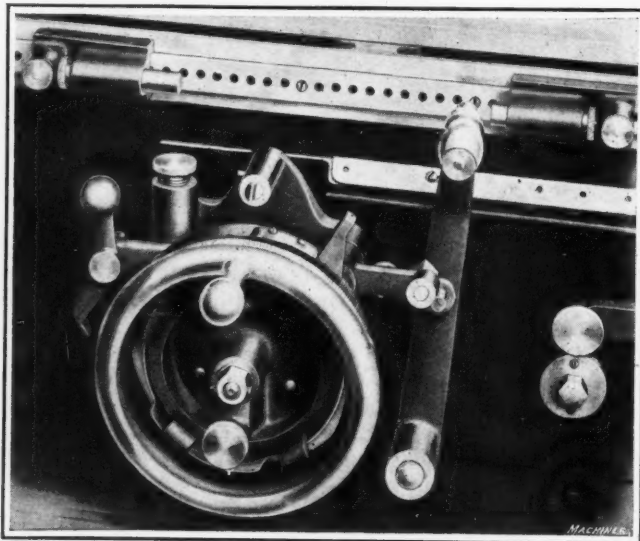
The readings obtained with this instrument are always the same for the same temperature, if the body viewed is surrounded by other objects, such as the walls of a furnace at the same temperature. Also no correction is required in the case of so-called "black bodies," such as incandescent carbon, when viewed in the open. For iron and steel in the solid state, the corrections required for readings taken in the open are also negligible. Objects having a metallic sheen, that is, a surface which reflects light freely, as molten metal or polished platinum, do not give the same readings when viewed in the open as when viewed in the furnace, or as a black body would give with this or any other radiation or optical pyrometer. The readings, however, are always consistent for the same material under the same conditions, and by using suitable reduction factors, can be converted to true temperatures. Furthermore, the readings obtained with this type of instrument when sighted upon a body in the open differ less from those given for the same body at the same temperature enclosed in a furnace, or for a black body at the same temperature, than do the readings of instruments which measure the total radiated energy. In other words, the correction where there is a departure from "black body" conditions is smaller than with the total radiation pyrometer.

The instrument can be calibrated by sighting it upon bodies the temperatures of which are known, either by means of a thermo-couple pyrometer, or by the melting or freezing of various substances. The constancy or reliability depends upon the constancy of the lamp, or its ability always to shine with the same intensity when receiving the same current. This matter has been investigated exhaustively by the U. S. Bureau of Standards and also in the laboratory of the Leeds & Northrup Co., and it has been found that after a tungsten filament is thoroughly aged, that is, burned for some time at a temperature higher than that to which it will be subjected in service, no sensible variation thereafter occurs. The instrument is so designed that one lamp can quickly be replaced by another, and by keeping two lamps, their correctness can always be insured by checking one against the other.

The instrument itself is handy and portable, weighing only a few ounces, and can be sighted as easily as an opera glass. The case, containing the battery, rheostat, and milli-ammeter, is slung about the neck, and weighs about ten pounds.

CROSS-FEED MECHANISM FOR OTT GRINDER

The Ott Grinder Co. of Indianapolis, Ind., has brought out a new design of universal grinding machine. The most notable feature of this machine is the automatic cross-feed mechanism,



Automatic Cross-feed Mechanism applied to No. 2 Universal Grinder built by the Ott Grinder Co.

which is shown by the accompanying detail illustration. In order to obtain simplicity and ease of adjustment, this mechanism has been equipped with a single rocker arm, a spring plunger and a stop-screw. When the table reaches the end of its stroke, the cross-feed rocker arm is swung down to its lowest position by a hardened pin on the reverse lever. As the table reverses its motion, the rocker arm is forced to move upward by a compressed spring. This upward movement continues until it is arrested by an adjustable stop-screw.

The pawl attached to the left-hand end of the rocker arm engages the cross-feed ratchet wheel, thus feeding the wheel slide. The feeding movement may be varied from 0.00025 to 0.003 inch. With this mechanism the grinding wheel is fed inward by the positive action of the reverse lever as it engages the rocker arm, whereas the spring previously referred to is simply relied upon to move the rocker arm and pawl back an amount depending upon the feed adjustment. The feeding movement may be disengaged by swinging over the feed pawl or by screwing down the adjusting stop. The feed may be disengaged automatically, a positive stop being provided for hand feeding.

METALWOOD STRAIGHTENING PRESS

The Metalwood Mfg. Co., Leib and Wight Sts., Detroit, Mich., is now manufacturing a straightening press in 20- and 35-ton sizes, and in three styles, including a motor drive, a belt drive from a lineshaft, and an accumulator drive. The particular press shown is equipped with a motor. The hydraulic pump for operating the press forms an integral part of the design and is of the two-plunger type. This pump is mounted upon the base, which forms a tank for the liquid. The pump body is of bronze, and the plungers are of tool steel, hardened and ground. The pump bearings are of phosphor-bronze. The ram of the press is returned by a heavy spring arranged for differential pull and with an adjustable tension. The ram nose has a sliding chrome-nickel steel resistance block with two steps for crank work, so as to reduce the stroke of the press whenever practicable and increase the operating speed.

The table is made of semi-steel and is provided with renewable steel strips upon which the centers are mounted and which take the thrust of the ram when pressure is applied to the part being straightened. The table is finished on the top and sides so that indicators can be used for testing the work. The centers are of the yielding type and are adjustable for length. The thrust is taken by tapered steel wedges placed under the work on the steel tracks. A single lever and a quick-operating valve serve to control the speed of the

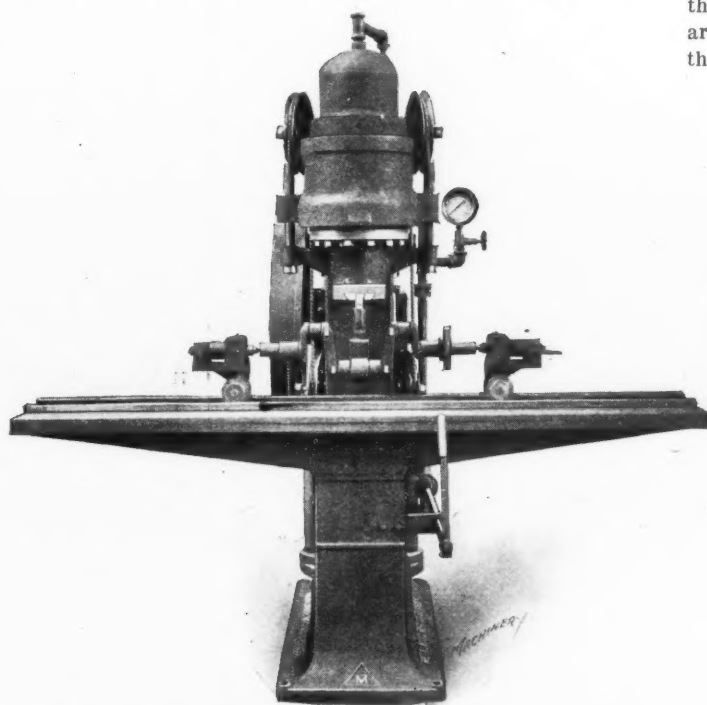


Fig. 1. Front View of Metalwood Straightening Press

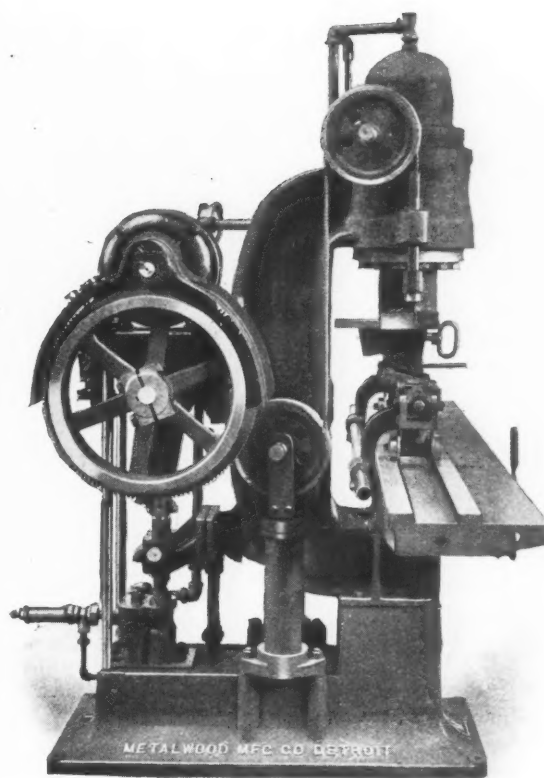
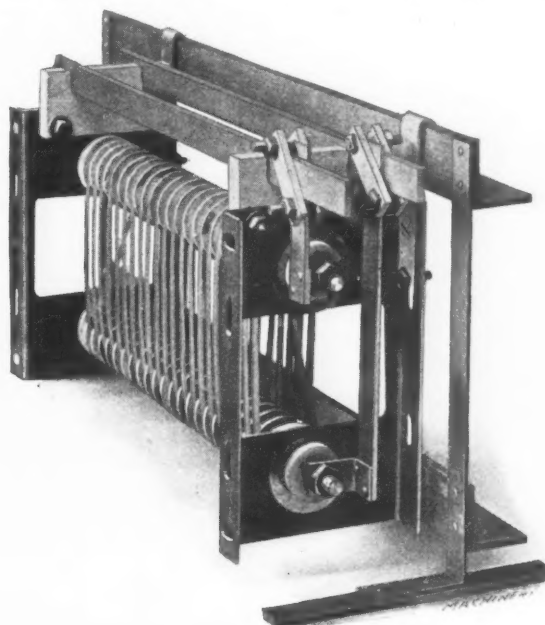


Fig. 2. Side View of Straightening Press

press ram, the pressure applied, and the return movement. All parts of the press subjected to heavy stresses are of alloy steel castings or forgings, and all piping under hydraulic pressure is of seamless steel tubing. The press is equipped with a gage reading in pounds per square inch and tons on the ram or applied to the work.

WESTINGHOUSE OVEN HEATER

An electrical oven heater designed especially for use in enameling or japanning ovens is illustrated herewith. This heater may also be applied for a variety of work where ovens are employed for a baking or drying process. The heating element consists of a ribbon wound on a number of fire-clay bushings assembled on two steel tie-rods, between two pressed steel end-plates. The ends of the ribbon are secured to drop-forged steel terminals, clamped to the steel tie-rods, which therefore become the terminals for the heaters. The tie-rods are insulated where they pass through the end frames, and the ends are threaded for bolting onto the connectors. Special



Westinghouse Type C Oven Heater

connectors are furnished to meet requirements. Cold-rolled steel bus bars are recommended, and may be mounted directly above the heater on insulators bolted directly to the end-frames. Connectors are secured to bus bars by steel clamps.

Hooks are used for hanging the heaters from the usual supporting steel work, which may be flat iron, angle iron, channel iron or pipe work. The hooks are bolted to the flanged end-plates of the heaters. Protecting screens may be attached directly to the flanged end-plates without any other means of support. Heaters may be mounted either on the side walls or on the floor, and in any position.

These heaters are normally rated at 2.5 kilowatts at 120 volts. Any number of them may be installed in an oven, and connected to any power circuit, whether single-phase or poly-phase and 110-220 or 440 volts. On 220-volt service, two heaters are connected in series, and on 440-volt service, four heaters are connected in series. Where three-phase power circuits are used, the heaters are connected three-phase, with the phases balanced. This heater (Type C) is made by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

DAVIS TOOL-ROOM LATHE

The "close-coupled" tool-room lathe now being manufactured by the Davis Machine Tool Co., Inc., Rochester, N. Y., has been designed to meet modern requirements as to accuracy, convenience, power and simplicity of construction. Front and rear views of this machine are shown in Figs. 1 and 2, and a sectional view of the headstock in Fig. 3. One of the important features of this lathe is the method of mounting the "back-gears," which are placed under the headstock at the front end of the spindle. The small cone gear that is usually located at the end of the cone next to the small step is placed

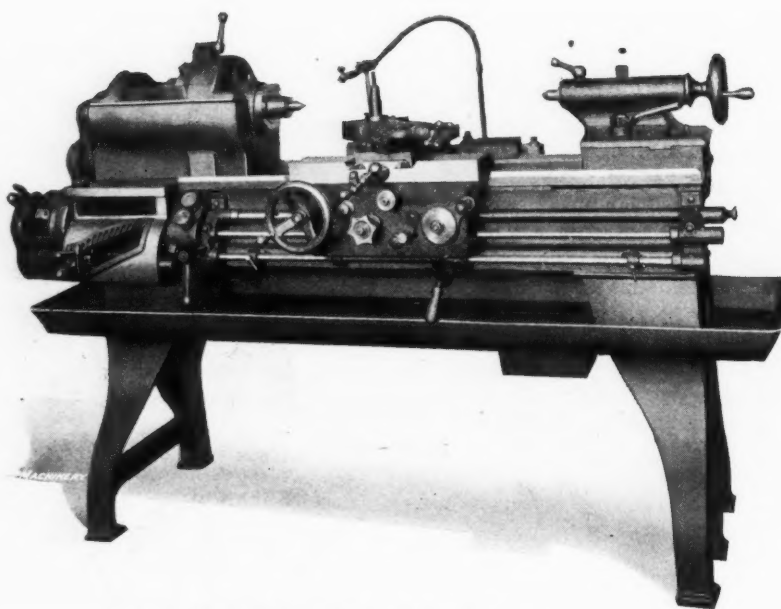


Fig. 1. Davis "Close-coupled" Tool-room Lathe

next to the large end of the cone. The back-gears are carried in a yoke which swings from a bearing at the back of the headstock. These gears are engaged with the cone gears by a cam operated from the front of the lathe by the small handle seen in Fig. 1 at the right of the gear-box. With this back-gear arrangement, the long eccentric shaft and quill common to cone-driven lathes, and the torsional strains to which this member is subjected, are eliminated.

The headstock is a heavy one-piece casting. Gear guards are integral with the headstock and form a cover for the cone pulley. At the top of the gear guard there is a brake for stopping the rotation of the spindle. This feature is of especial value when frequent inspection or gaging is necessary. The crucible steel spindle is mounted in heavy phosphor-bronze boxes, which are lubricated from large oil pockets by means of rings. The front spindle bearing is tapered to compensate for wear. The carriage has a bearing

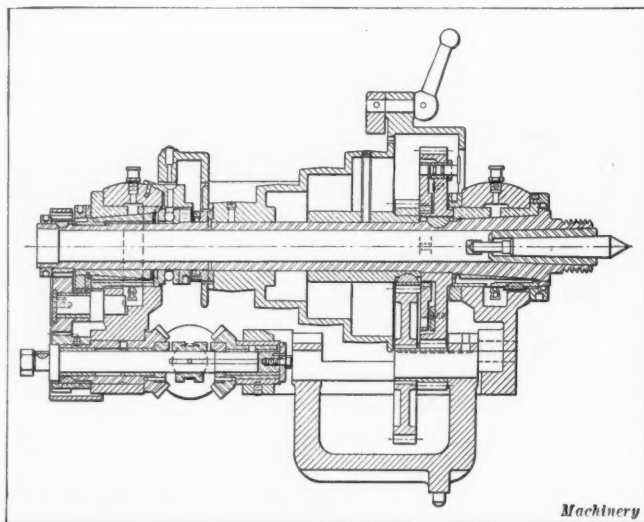


Fig. 3. Headstock of Davis Lathe

of 19¼ inches on the ways and a cross-bridge 6 inches wide. The compound rest is provided with four clamping bolts for holding it rigidly in any position.

The apron is of the double-plate type with two bearing supports for all shafts. A central oil pocket is arranged to lubricate all bearings from one point. The apron has the usual interlocking feature to prevent engaging the feed-nut and half-nut at the same time. The lever seen in Fig. 1 beneath the right-hand end of the apron serves to reverse the movement of the carriage by shifting a sliding clutch interposed between bevel gears located beneath the headstock. The same rod that operates this reverse mechanism carries adjustable collars for stopping the feeding movement of the carriage at any point. This lathe has a screw cutting capacity varying from 1½ to 80 threads per inch, including 11½. The regular equipment provides thirty-six different leads or pitches, and this number can be increased by applying change-gears to the quadrant. The maximum error allowed in the lead-screw is 0.001 inch per foot. Thirty-six different feeds are provided, the feeding movement being transmitted through an independent feed-rod. All gears in the quick-change gear-box are made of steel and generated on a gear shaper.

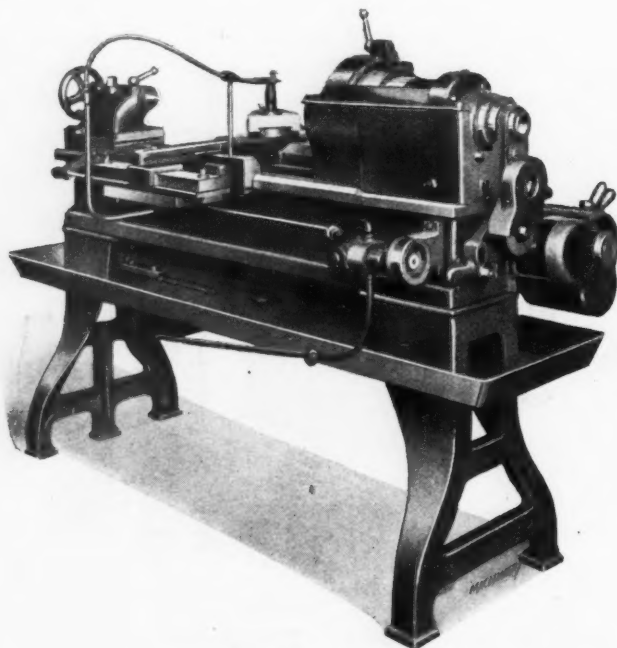
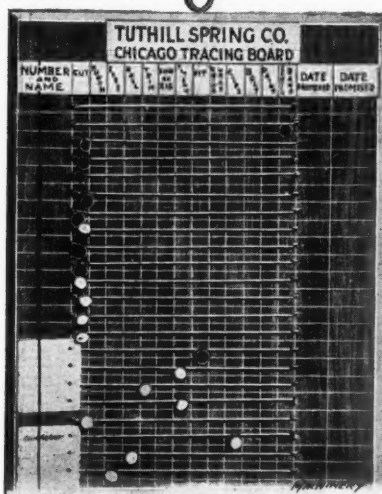


Fig. 2. Rear View of Davis Lathe

To insure correct alignment, an extra foot is placed in the center of the right-hand leg, so that the lathe has a three-point support. The outer ends of the right-hand leg are provided with adjusting bolts which can be screwed down until they just touch the floor, thus overcoming any rocking tendency. The bed of this machine is ribbed transversely with heavy double-wall crossgirds. The rear end is low enough to

permit sliding off the tailstock without disengaging the clamping bar or removing bolts. The manufacturers will supply this machine with a motor drive if desired. The motor is mounted

over the headstock and is geared to the spindle through a train of gears which provide four mechanical changes by sliding clutches. Further speed changes are obtained through the motor, which should have a variation of from 500 to 1500 revolutions per minute. This lathe may be equipped with a taper attachment, draw-in chuck and collets, transposing gears for cutting metric pitches, and a relieving attachment if desired by the purchaser.



Board for following Progress of Orders through the Plant

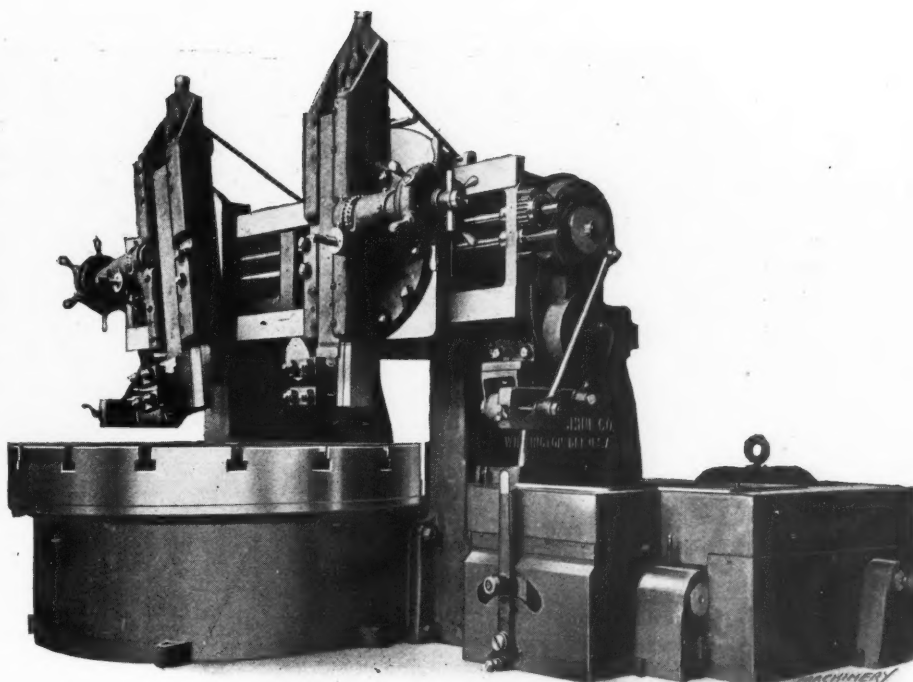
TUTHILL SPRING CO.'S TRACING BOARD

The tracing of orders so that delays are noticed, the causes discovered, and deliveries made on schedule time, is a problem common with all manufacturers. Tuthill Spring Co., Kesner Bldg., Chicago, Ill., formerly followed the progress of orders through their plant by a card index system. Every day the exact location of each job was noted on a card, and the superintendent or shipping clerk was kept posted on just what was taking place by referring to the cards.

The tracing board, the upper section of which is shown in the illustration, was devised to facilitate this work. This particular board is used in tracing Chicago orders. Each day the entry clerk, in a much shorter time than it took to make the card records, can bring his tracing board up to date. A glance tells the superintendent, or anyone else interested, the exact status of each job.

BETTS TIRE TURNING AND BORING MILL

A 66-inch tire turning and boring mill recently built by the Betts Machine Co., Wilmington, Del., is shown in the



Betts Tire Turning Mill

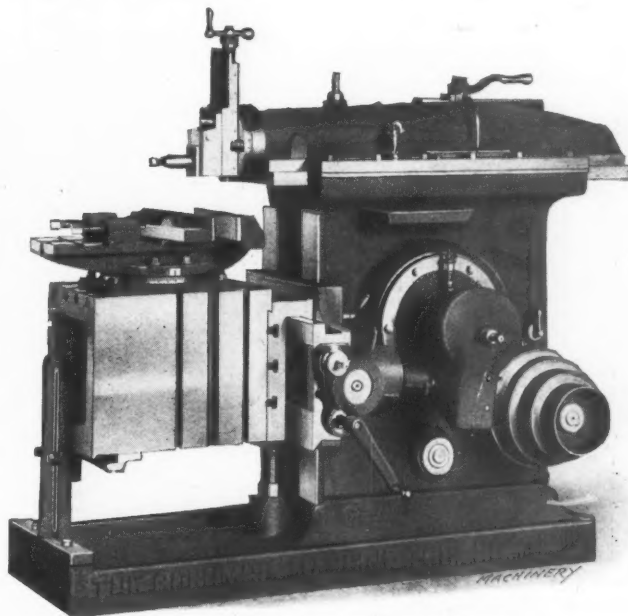
accompanying illustration. The machine swings diameters up to 72 inches and takes work 16 inches high under the saddles. It is driven by a twenty-five-horsepower electric motor. The general design of this machine is similar to that of a standard boring mill, but owing to the extremely severe duty for which the machine is intended, it has been made exceptionally strong. All driving gears are of steel, thoroughly covered, and

provision is made to lubricate them properly; all feed gears, saddles and tool spindles are of steel, and the latter are independently counterbalanced and have rapid hand movement. Separate feed works are provided for each side of the machine, and the feeds can be changed quickly without stopping the machine.

The necessary speed changes are obtained through the field control of the motor in connection with two or three mechanical changes. This style of machine is built in five different sizes, ranging from 66 inches up to 108 inches, and it can be furnished with a movable instead of a fixed cross-rail so that it may be used for general machine shop work as well as for tire work.

COLUMBIA 20-INCH CRANK SHAPER

The heavy-duty crank shaper illustrated herewith is a 20-inch size built by the Columbia Machine Tool Co., Hamilton, Ohio. The column of this machine is made straight in front in order to permit the head to be set at an angle without interfering with its full travel across the table. The feed mechanism of this machine is designed along somewhat different lines from usual; it is carried in a housing which covers and protects the gears, and is an adaptation of the well-known



Columbia 20-inch Heavy-duty Crank Shaper

ratchet type. Feed changes may be made quickly, and a safety stop is provided, as well as means of controlling and indicating the direction of the feed. There are eight feed changes in all.

The position of the ram and the length of the stroke can readily be adjusted from the front of the machine. The ram is held in place by clamping gibs on top of the column, and an angular gib at one side of the ram provides adjustment for wear. The tool-head has a micrometer adjustment and is graduated for angular adjustment. The machine is provided with back-gears, which, in connection with the four-step driving cone pulley, give eight speed changes in geometrical progression. The table is of box form and long enough to accommodate work up to the full rated capacity. In addition to the regular T-slots, a V-groove is formed in one side of the table for holding round stock. The vise regularly furnished is of the double-screw type and has a graduated swiveling base.

WESTINGHOUSE AUTOMATIC STARTERS FOR INDUCTION MOTORS

Several automatic starters for motor-driven machinery, (manufactured by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.), are shown in Figs. 1 to 4 inclusive. These automatic starters are for use with single-phase or polyphase squirrel-cage and wound-rotor induction motors, where it is desired to start the motor from a remote point or where automatic acceleration is required to guard against improper starting by unskilled operators. They are simple, reliable, and rugged in construction, consisting of a magnetic contactor panel and a master switch, which may be either a push-button, a float switch, a pressure regulator, or similar device for closing the control circuit, depending upon the service. The vital element is the magnetic contactor. The contactors used on these starters have been employed successfully in steel mill, cement plant, and mine installations, where the requirements are extremely severe. The contactors are opened by strong spring action assisted by gravity. The destructive action of the arc is reduced to a minimum by strong blow-out coils and arcing horns.

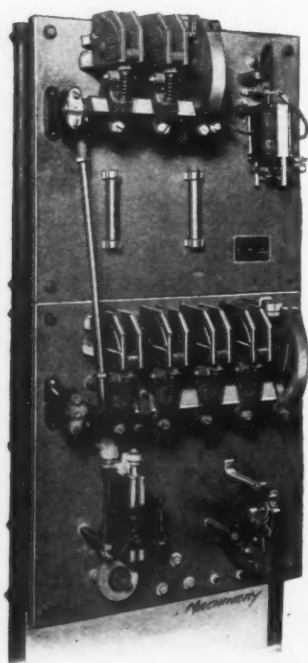


Fig. 1. Automatic Starter of Transformer Type

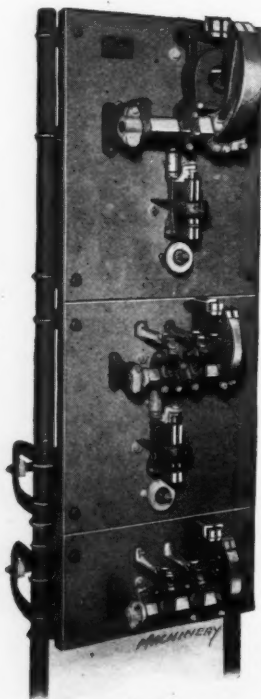


Fig. 2. Westinghouse High-voltage Starter

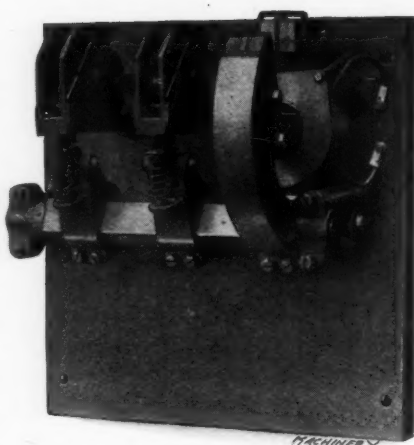


Fig. 3. Magnetic Contactor Panel



Fig. 4. Gage Type Pressure Regulator

The operation of the starters is very simple. When starting motors driving lineshafts, woodworking, and machine tools, and similar apparatus, it is only necessary to press a button, and close a small knife or snap switch. The starter then automatically makes the proper connections to limit the starting current to a suitable value and to vary the time required for acceleration according to the load on the motor, thus preventing damage to the machinery by too slow or too rapid acceleration, and saving time by bringing the motor to full speed at the most rapid permissible rate. When used for pump or compressor service in connection with a float switch or pressure gage, the action of the starters is entirely automatic, the motors being started when the pressure or liquid level of the tank control falls to a predetermined point, and stopped when the desired maximum pressure or level is reached, or *vice versa*.

The automatic starters for squirrel-cage motors are most frequently employed for starting motors operating centrifugal pumps, air compressors, fans, blowers, metal-working and wood-working machines, and other apparatus requiring starting torque less than full load torque. This type of starter, however, owing to the wide application of squirrel-cage motors for industrial service, can be applied economically for starting service in nearly every industry.

Squirrel-cage motors of five horsepower and smaller are usually connected direct to the line. Large squirrel-cage motors are first impressed with low voltage from auto transformers or connected to the line through resistance so that in either case the starting current is reduced. When the speed of the motor has reached such a point that the starting current has decreased sufficiently the motor is then automatically connected to the line.

The automatic starters for wound-rotor motors are particularly adaptable for starting motors driving plunger pumps, positive pressure blowers, air compressors, long lineshafts, and loads having heavy inertia. The severe starting conditions encountered in this class of service require from 100 to 200 per cent full load torque in starting, making automatic starting a very desirable feature.

When an automatic starter is used in connection with a wound-rotor motor, the line switch is first closed, with the maximum resistance in the rotor circuit. When the speed falls to a predetermined value, a relay closes a magnetic contactor which cuts out a part of the resistance in the rotor circuit. Each contactor operates in a similar manner, cutting out its portion of the resistance at the proper time until all the resistance is short-circuited by the last contactor.

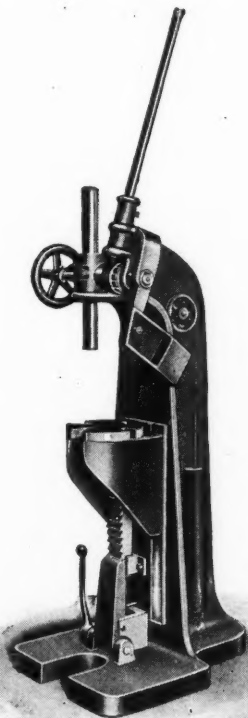
The power on any circuit may fail suddenly, and it is important that some protection be afforded both operator and motor against an unforeseen return of power. This protection may be provided for motors operating pumps, compressors, etc., by a low-voltage release to disconnect the motor from the line when the voltage is low or the power fails entirely. Then as soon as the power returns, the motor will automatically start up again. In many applications, however, such as for motors operating machine tools or wood-

working machines, low-voltage protection is required. Motors so protected are disconnected from the line when the power fails and will not start when the power comes on again until the operator presses a button or manipulates a similar device; hence, there is no danger from the unexpected starting of a machine.

The advantages resulting from the use of automatic starters for induction motors comprise absolute protection to both operator and machinery, proper starting at the most rapid permissible rate, economy in operation and maintenance, convenience of remote control, and automatic operation.

FOX ARBOR PRESS

The Sunderland Machinery & Supply Co., 1006-1010 Douglas St., Omaha, Neb., has placed on the market an arbor press known as the Fox "high-speed" No. 4, that is designed for rapid operation and adjustment. The press is equipped with a special type of mechanism for elevating and lowering the



Fox No. 4 Arbor Press

table easily and rapidly. The table is counterbalanced by a weight at the rear of the press so that it can easily be raised or lowered. It is elevated by grasping the handle at the left-hand side and simply lifting it, and is held in position by the rack and pawl shown beneath it. In order to lower the table the pawl is first disengaged from the rack by a lever provided for that purpose, and the table is then pushed down to the required position. The press ram is operated by a counterweighted ratchet lever, as the illustration shows. The frame and table are of cast iron, and the rack, pinion, pawl and ratchet are

made of a special alloy steel properly heat-treated. This press will take diameters up to 19 inches, and the capacity over the table is 30 inches. The ram has a movement of $17\frac{1}{7}$ inches and the leverage is 60 to 1. The weight of the press is 1100 pounds.

SKELTON TAPER REAMER

The taper reamer shown in Fig. 1 is designed for reaming taper holes and has a flat, high-speed steel blade and a low-carbon steel holder. The edge A, Fig. 2, is ground to a circular form, and between this edge and the heel B there is a flat surface. The heel is backed off or relieved sufficiently to allow for the maximum cut and still prevent "hogging in," the depth of cut being positively controlled by the clearance or amount ground away at B. The curved flutes C, adjacent to each cutting edge, provide rake so that the reamer cuts the metal instead of scraping it. The method of holding the blade allows

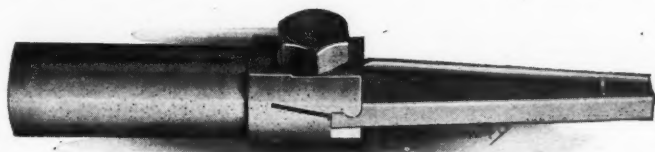


Fig. 1. Skelton Taper Reamer

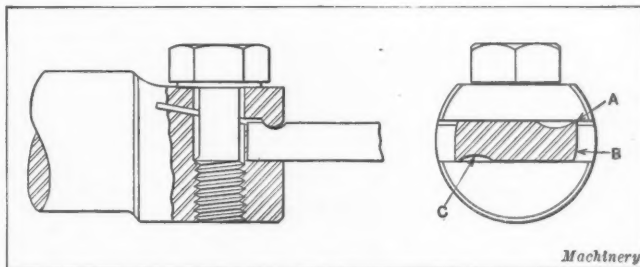
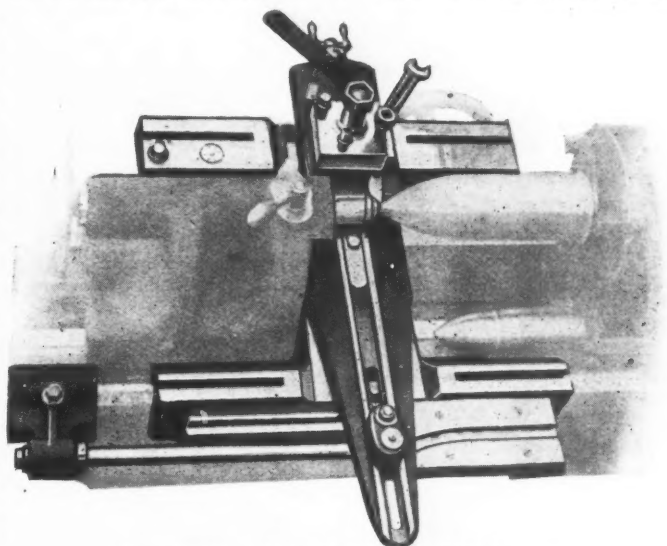


Fig. 2. Connection between Blade and Holder of Skelton Reamer

for lining up the reamer with the spindle in case the turret hole is out of alignment. As Fig. 2 shows, the end of the holder is split and it has a circular tongue which engages a circular groove extending across the end of the reamer blade. The tongue is offset slightly with reference to the groove in the blade so that the blade is forced back into the bottom of the slot, thus aligning it with the holder. The clamping screw is of nickel steel, heat-treated and so arranged that the pressure comes in front of the holder. This reamer has been placed on the market by Charles E. Skelton, 107 N. Franklin St., Syracuse, N. Y.

SHELL FORMING ATTACHMENT FOR CINCINNATI LATHES

An attachment for use when turning shells is shown in the accompanying detailed view as applied to one of a number of 18-inch lathes built by the Cincinnati Lathe & Tool Co., 3207-3211 North St., Oakley, Cincinnati, Ohio. A shell made of 50-point carbon steel, having a 12-inch radius, was finished to the required size and form with an attachment of this type in 16 minutes, 48 seconds. The actual cutting speeds varied



Shell Forming Attachment applied to Cincinnati Lathe

from 69 to 204 feet per minute, owing to the curvature of the shell, and a feed of $\frac{1}{32}$ inch was used. The attachment illustrated is equipped with a cam for forming 6-inch shells.

ARMSTRONG-BLUM METAL-CUTTING BAND SAW

A universal metal-cutting band saw, which is the product of the Armstrong-Blum Mfg. Co., 343 N. Francisco Ave., Chicago, Ill., is shown in a vertical position in Fig. 1, and in Fig. 2 with the saw blade tilted to an angle of 45 degrees for cutting an 18-inch beam. The saw may be inclined to a 45-degree angle, either to the right or left, and its position is indicated by suitable graduations. The saw blade is mounted on two flanged wheels supported by a rigid frame, which is pivoted to a frame or cage under the table. This cage is equipped with four hardened roller bearings that travel in planed dirt-proof races. The automatic feeding movement may be engaged or disengaged by means of a small lever at the front of the machine.

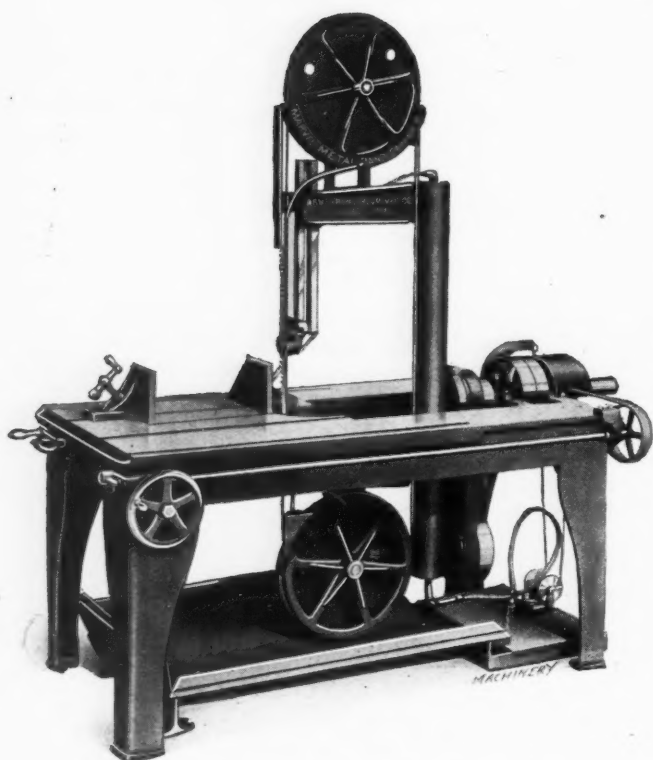


Fig. 1. Armstrong-Blum No. 8 Metal-cutting Band Saw

The required pressure is imparted to the saw blade by a bronze worm-gear having cork inserts, two friction disks, a spring and an adjusting nut. Lubrication is supplied to the saw blade at the cutting point by a submerged centrifugal pump, the lubricant passing directly through the teeth at the point of delivery. The saw blade guide rollers have double ball bearings and felt dirt-proof rings. The machine may be stopped at any required depth of cut by a knock-off dog or trip. The saw table is 32 inches wide, 5 feet long, and has four T-slots. The two inner slots are machined and notched to receive the vise jaws, which may be placed wherever needed or be removed entirely. The drip-pan is telescopic and designed to catch the lubricant when the saw blade is inclined 45 degrees either way from the vertical. The speed of the saw

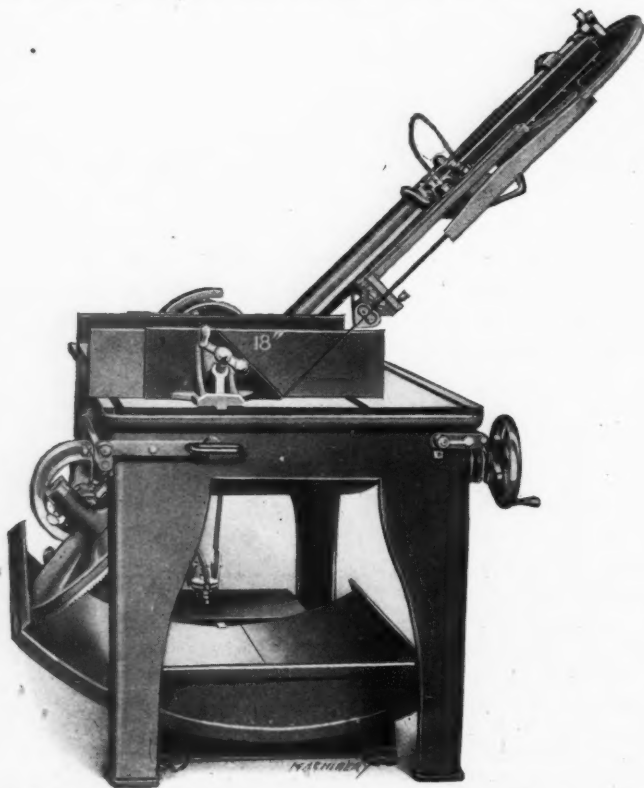


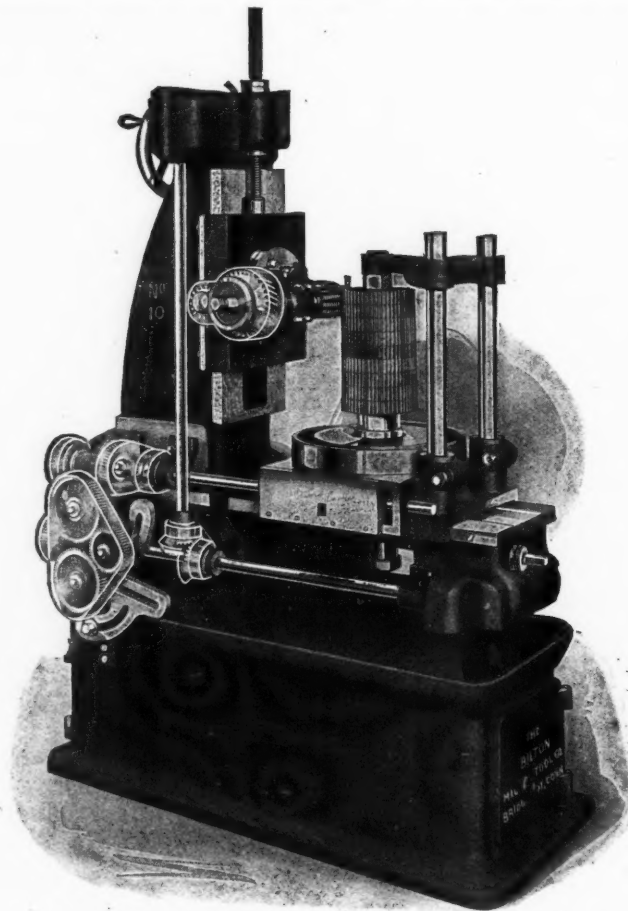
Fig. 2. Metal-cutting Band Saw set at Angle of 45 Degrees for cutting 18-inch Beam

may be increased about 90 per cent by means of double cone pulleys. This machine has a throat capacity of 18 by 20 inches. The saw blade is 14 feet, 8 inches long, $\frac{5}{8}$ inch wide, and 0.032 inch thick. Guards are provided wherever necessary.

BILTON UNIVERSAL GEAR-HOBGING MACHINE

A universal gear-hobbing machine recently added to the gear-cutting equipment of the Bilton Machine Tool Co., Bridgeport, Conn., has a rated capacity for gears of 10 inches outside diameter, 10 diametral pitch and 10 inches width of face. The work-table of this machine (see accompanying illustration) is driven through a steel worm and a bronze worm-wheel $11\frac{1}{2}$ inches in diameter. The worm is automatically lubricated and is fitted with a ball thrust bearing. Automatic stops are provided for the vertical and horizontal feeding movements, and the horizontal feed shaft has a micrometer dial. The differential gears and the feeding and indexing gears, which are on the rear end of the machine, all have teeth of 14 diametral pitch, so that they are interchangeable, and the total number is reduced to a minimum.

The vertical slide is made extra long and has flat ways with large bearing surfaces. The hob spindle head carried by this slide may be set at any desired angle for cutting right- or left-



Bilton No. 10 Universal Gear-hobbing Machine

hand spirals. The hob spindle is driven through helical gears, and it may be adjusted lengthwise to relocate the hob if it should become dull in one place, without disturbing the adjustment of the spindle bearings. The work-table has a central hole $1\frac{3}{8}$ inch in diameter, so that teeth can be hobbed on the ends of shafts up to $1\frac{3}{8}$ inch diameter and 24 inches long. The table has deep oil-grooves with a drain running to the base of the machine where the oil reservoir is located. This reservoir is removable so that it can be cleaned. The hob speeds vary from 50 to 250 revolutions per minute and the range of hob feeds per revolution of the work is from 0.010 to 0.125 inch. The machine is driven through a three-step cone pulley designed for a $2\frac{1}{2}$ -inch belt. The net weight of the machine is 1100 pounds.

UNITED STATES ELECTRICAL GRINDER

The United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, Ohio, is now building a combination wet and dry grinding machine that is electrically driven. This grinder is built in two sizes, with motors of three and five horsepower capacity. The machine equipped with a three-horsepower motor is arranged to carry two grinding wheels 12 inches in diameter by 2 inches face width, and the five-horsepower machine carries two grinding wheels 18 inches in diameter by 3 inches face width. These grinders are equipped with either direct-current motors for 110-, 220- or 550-volt circuits or alternating-current motors for 220-, 440- or 550-volt circuits of 25 or 60 cycle and two or three phase.

The bearings used in these machines are of the self-aligning ball bearing type, and the motors are built by the Westinghouse Electric & Mfg. Co. The grinding machine equipped with a three-horsepower motor weighs 575 pounds, and the



United States Electrical Grinder

machine equipped with a five-horsepower motor weighs 700 pounds. The speed of the grinding machine driven by a three-horsepower motor is 1800 revolutions per minute, and the machine driven by a five-horsepower motor runs at 1120 revolutions per minute.

NEW MACHINERY AND TOOLS NOTES

Plug Gages: Simplex Tool Co., Woonsocket, R. I. A standard line of hardened tool steel plug gages varying by 1/32 inch from 1/8 to 1 inch in diameter.

Cutter Grinder: Elmer Sacrey, 1001 Diamond St., Philadelphia, Pa. A grinder for sharpening milling cutters up to 9 inches in diameter. The machine is equipped with a diamond wheel-truing device.

Pneumatic Hammer: H. Edsall Barr, Erie, Pa. This hammer strikes a maximum of 200 blows a minute and has a capacity for stock up to 2 inches square. The hammer is arranged to permit continuous striking.

Engine Lathe: Richard H. Kiddle, Kinsman, Ohio. Fourteen-inch engine lathe of cone pulley type, with beds varying from 4 to 10 feet in length. The swing over the carriage is 8 3/4 inches, and the weight, 1200 pounds.

Grinding and Polishing Stand: Lamb Knitting Machine Co., Chicopee Falls, Mass. A ball bearing grinding, polishing, and buffing machine. The head is separate from the base so that the machine may be used either as a bench or pedestal type.

Grinding and Buffing Stand: U. S. Electrical Mfg. Co., Los Angeles, Cal. This is a self-contained, motor-driven tool equipped with ball bearings that are sealed against dirt and grit. The machine may be supplied for bench mounting or with a pedestal.

Hydro-pneumatic Press: Metalwood Mfg. Co., Leil and Wight Sts., Detroit, Mich. A press for subjecting high-explosive and shrapnel shells to internal pressure. Presses of this type are built in various sizes with pressures ranging from 2000 to 21,000 pounds per square inch.

Bender for Ship Frames: Watson-Stillman Co., 192 Fulton St., New York City. Hydraulically-operated bender designed for bending heavy steel ship frames, deck beams, etc. The machine is mounted upon broad rollers so that it can be moved along the work when bending long parts to the shape of a template.

Polishing Machine: Harvard Machine Co., Harvard Square, Cambridge, Mass. Polishing and lapping machine provided either with a No. 2 Morse taper spindle or with spring chucks for accommodating work up to 1/2 inch in diameter. These machines are intended especially for tool-room use in lapping bushings, plug gages, etc.

Pyromagnetic Indicator: Pyromagnetic Instrument Co., 175 N. Jefferson St., Chicago, Ill. An instrument of the magnetic type for determining the critical point when heating steel parts for hardening. One end of the instrument is energized and is placed in contact with the steel, which is heated until it becomes non-magnetic.

Universal Curvegraph: W. G. Classon, Leominster, Mass. An instrument for the use of engineers and draftsmen, adapted for drawing simple, compound, reverse, and irregular curves. The spline or part for guiding the pen or pencil is held by adjustable fingers provided with graduations indicating the radius of curvature.

Automatic Threading Lathes: Automatic Machine Co., Bridgeport, Conn. These lathes operate on the same general principle as those formerly manufactured, but differ in some of the details. They are adapted for single or multiple thread cutting on either right- or left-hand screw threads. Forged tools or circular form cutters may be used.

Two-spindle Milling Machine: Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. A machine of the type having a horizontal planer type table equipped with two spindles, one being vertical and the other horizontal. The maximum height under the vertical spindle is 36 inches, and the width between the uprights, 42 inches.

Vertical Bending Rolls: Southwark Foundry & Machine Co., Philadelphia, Pa. A large bending roll for boiler plates having rolls which are vertical instead of horizontal. Two of the three rolls in the set are 22 inches in diameter, and the third roll is 30 inches in diameter. The driving motor and mechanism is located in a pit beneath the floor.

Cold Saw: Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa. A cold metal-cutting saw for handling heavy structural steel sections. The machine is equipped with a 56-inch saw blade, but this may be increased to 62 inches in diameter if necessary. With the smaller blade the machine will handle rounds up to 16 3/4 inches, squares up to 15 1/2 inches, and oblong sections up to 17 by 58 inches.

Power Shear: Buffalo Forge Co., Buffalo, N. Y. A line of power cut-off shearing machines. These shears are mounted on wheels to make them portable, and individual electric motor drive makes the entire machine self-contained. Four sizes of shears are built, the largest of which has a capacity for cutting flat bars up to 1 1/4 by 5 inches, round stock up to 1 3/4 inch in diameter, square stock up to 1 1/2 inch, and angles up to 5 by 5 by 9/16 inch.

Spline Milling Attachment: Standard Engineering Works, Pawtucket, R. I. An attachment of the vertical type for use on hand and weight-fed milling machines. It is adapted for milling tang slots, feather keyways, etc. A cam operated by a ratchet gear controls the vertical movement of the cutter, and the spindle returns to an upright position automatically after reaching the proper depth. The horizontal travel is controlled by an automatic trip.

Sandblast Room: American Foundry Equipment Co., 52 Vanderbilt Ave., New York City. A compartment for the protection of the operator when sandblasting. The compartment or room has a circular table which extends beyond the enclosed part at the rear, so that it can be loaded while the work inside the compartment is being operated upon. The sandblast nozzle is inserted through a slit covered with rubber flaps, and the work may be seen through a fine brass screen.

Power Press Guard: G. H. Scott Machine Co., Cleveland, Ohio. This guard is entirely independent of the press treadle. Accidents due to repetition of the press are claimed to be impossible, and it is also stated that interference with the production of the machine is avoided, as well as accidents to the dies and the press. The guard is actuated by a cam and roller, and descends ahead of the ram, but the work is visible at all times and the operator has free use of his hands.

Dynamic Balancing Fixture: N. K. Akimoff, 1013 Harrison Bldg., Philadelphia, Pa. A fixture applied to an engine lathe for testing the dynamic balance of revolving machine parts. One end of the part to be tested is held in the chuck while the other rests on rollers having a yielding support. The position of an adjustable member is changed until an indicator dial shows that the part is in balance. The amount and location of excess metal to be removed by drilling is determined by reference to special tables.

Wire Nail Machines: Sleeper & Hartley, Inc., Worcester, Mass. Distinctive features of these machines consist of the employment of toggle joints actuated from a single crankshaft to provide the working motions, separation of the pointing and heading operations, and reduction in the size and weight of the machines and the floor space which they occupy. In operation, wire is taken from a coil and run through straightening rolls. During a single revolution the wire is fed forward to form the nail blank, the blank is cut off and the incoming end pointed. In the meantime the previously cut-off blank is headed.

* * *

MR. SHIPLEY RETIRES FROM THE LODGE & SHIPLEY MACHINE TOOL CO.

Mr. Murray Shipley has sold his holdings in the Lodge & Shipley Machine Tool Co. of Cincinnati to Mrs. Lodge and her daughters, and given up all connection with that business. Mr. Shipley states that his retirement from the company does not necessarily indicate a permanent retirement from business, but rather a relief from the close attention which he has had to give to details for twenty-five years. Mr. Shipley has been identified with the concern since its establishment by Mr. Lodge and himself in August, 1892, and his activity in the machine tool business has covered a period of great progress and expansion in the industry, of which the Lodge & Shipley Machine Tool Co. has had its full share, starting from a small shop on Culvert St., from which it was moved to its present location, where the plant and business has steadily increased until it is now one of the largest and best known in the world. The new officers of the company are Mrs. M. G. Lodge, president; J. W. Carrel, vice-president and general manager; and L. A. Hall, secretary and treasurer. It is stated that the policy and organization of the company will continue on the same progressive lines as before. J. W. Carrel, the vice-president and general manager, has had many years of training and experience in the manufacture and sale of machine tools, having been connected with several well-known concerns before he became sales manager for the Lodge & Shipley Machine Tool Co. Mr. Carrel is widely known and highly regarded in the industry, and under his management the business will undoubtedly continue moving onward and upward.

* * *

RELIEVING ATTACHMENT FOR LATHE

The Phoenix Mfg. Co. of Eau Claire, Wis., has equipped one of its engine lathes with a simple attachment for relieving hobs, taps and various forms of milling cutters. It will be seen that this consists of a gear *A* mounted on the lathe spindle nose, from which power is transmitted to compound gears *B*, carried on a bracket at the back of the lathe. These compound gears may be changed to suit the cutter that is being relieved. Secured to the last gear of the compound train there is a cam *C* which has the same number of lobes as there are flutes in the cutter.

A roller mounted at the end of crank *D* runs in contact with cam *C*, and is secured to an eccentric shaft *E* mounted in bearings at the back of the lathe bed.

By disengaging the cross-feed screw in the lathe carriage, the cross-slide is left free and connection is made between it and the eccentric on shaft *E* by means of a connecting-rod *F*. It will be apparent that cam *C* and crank *D* impart an oscillating movement to eccentric shaft *E*, from which a corre-

sponding reciprocating movement is imparted to the cross-slide on the carriage. In this way the necessary motion is obtained to give the cutter teeth the required relief. Different cams *C* and combinations of compound gears *B* are employed according to the type of cutter that is to be relieved. Cam *C* must, of course, have the same number of lobes as there are flutes in the cutter. Springs *G* hold the cross-slide so that all lost motion in the mechanism is taken up and accurate results are secured.

E. K. H.

* * *

"COLLEGE OF THE MIDNIGHT LAMP"

BY GUY H. GARDNER¹

Though not wholly unfamiliar with other institutions of learning, I hold high opinions of the "College of the Midnight Lamp." Just now I have a small yarn to spin in regard to it. Last November a young apprentice wrote asking me to tell him how to find by a lay-out, as he knew no mathematics beyond long division, how far apart to place the tacks to draw an ellipse 8 by 12 inches. I learned subsequently that he wished to make a hole for an 8-inch stovepipe. In the last week of November he began the "midnight" study of plane geometry. In January of this year he began trigonometry. March 24, in response to his request for "something a little harder," I sent him a trigonometric problem which I have put before successive generations of high school and academy boys without finding one who could solve it. It is simple, but depends on the formula for the sine of twice an angle. My apprentice friend sent me the solution by return mail. Rah for the "College of the Midnight Lamp!" He is now working on the mathematics of gearing, and asks me to help him later with navigational astronomy, as he thinks "a man ought to have a hobby unconnected with his daily work."

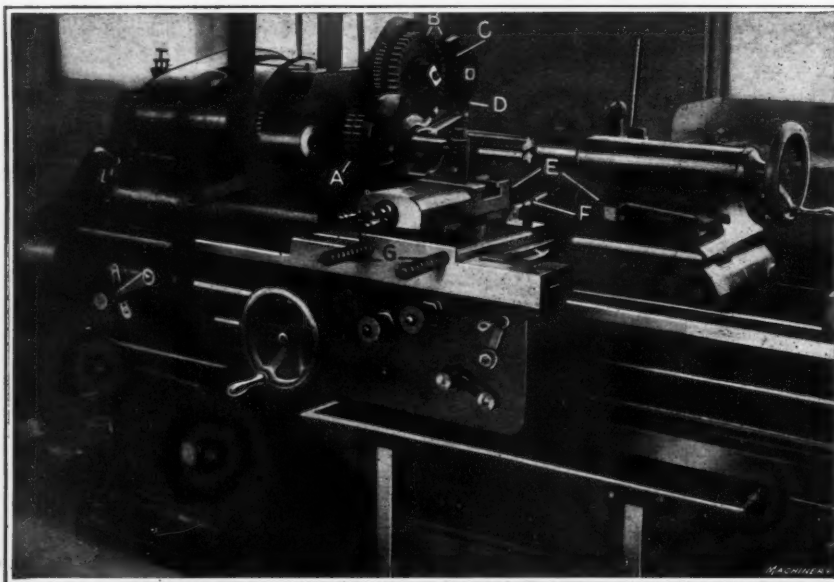
His father writes that he has never seen so marvelous a transformation of character. No more loafing, no more "movies," just hard work, which is not hard because he loves it. That boy will amount to something. I could tell a dozen tales of men who have subscribed to MACHINERY to get rid of an importunate solicitor, and have undergone, in consequence, as complete a change of character as this youngster. Billy Sunday "has nothing on" MACHINERY as an agent of reformation.

* * *

GRINDING WHEEL BALANCE

Howard W. Dunbar calls attention to the need of perfect grinding wheel balance in *Grits and Grinds*, asserting that probably nine-tenths of all trouble with cylindrical grinding machines is caused by the efforts of the operator to obtain good work by tightening the boxes so as to prevent an out-of-balance wheel causing marks on the work. Out-of-balance

wheels set up vibrations throughout the whole machine, which cause chatter marks in the work; they are more likely to break than wheels in balance; they wear out the spindle boxes rapidly; and are more destructive to diamond truing tools, requiring more frequent dressing. Out-of-balance wheels, therefore, are more expensive than wheels in balance because of more rapid wear and their deteriorating effect on grinding machinery.



Lathe Attachment for relieving Milling Cutters, Taps and Hobs

¹Address: New London, N. H.

SPOT-FACING TOOLS

BY F. B. JACOBS¹

Spot-facing tools and counterbores are often spoken of as the same thing, but there is a slight difference between them. As a general thing, a spot-facing tool is used to finish off a surface, although it is sometimes used to counterbore a hole slightly. On the other hand, a counterbore is generally used for counterboring comparatively deep work and sometimes for enlarging a hole that has been drilled, particularly when several holes are so near together that they break into each other. There are many varieties of spot-facing tools, but this article will be confined to some of the more simple forms that have been found efficient in everyday work, especially in the automobile industry.

The simplest form of spot-facing tool is shown in Fig. 4. This consists of a bar of the requisite length having a hole drilled and reamed near the bottom to accommodate the cutter, which is held in place by a set-screw. Owing to the ease with which it is made, this tool is a favorite with those employed on experimental work, who often have occasion to face off several bosses of different sizes. If the tool is of medium size, say with a one-inch shank, it can be made by a machinist in about one hour.

The only feature calling for any degree of accuracy is the angle made by the shank and the bar, which should be 90 degrees. This tool is comparatively short-lived, as it has only one cutting edge, but when only a few holes are to be spot-faced it serves the purpose as well as some of the more elaborate and costly forms.

A more substantial form of spot-facing tool is illustrated in Fig. 5. This consists of a shank to which the cutter, which closely resembles a hollow-mill, is fastened by means of a cone-

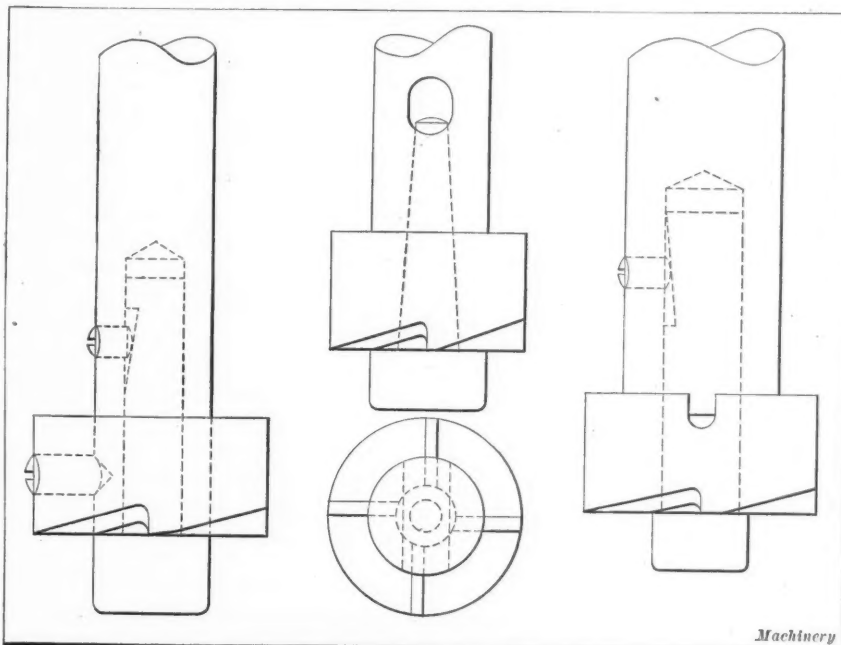


Fig. 1. Spot-facing Tool with Interchangeable Cutter

Fig. 2. Convenient Form of Spot-facing Tool for Small Sizes

Fig. 3. Spot-facing Tool in which Cutter is driven by Projections on Shank

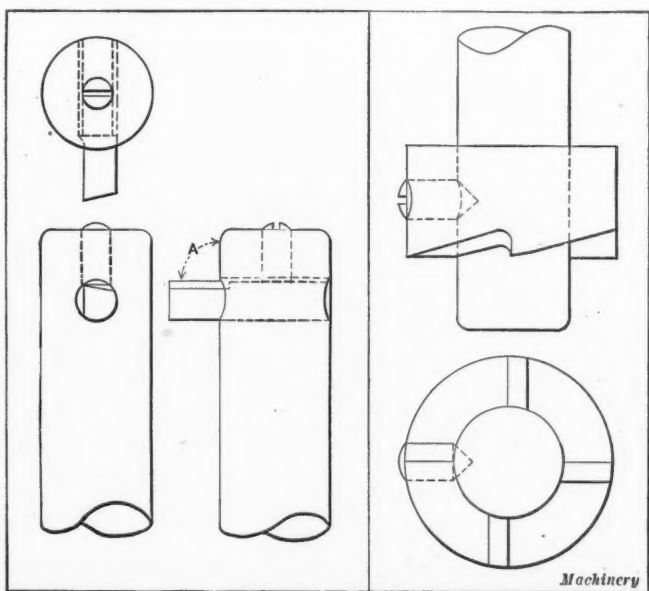


Fig. 4. Simplest Form of Spot-facing Tool

Fig. 5. Rapid-production Spot-facing Tool

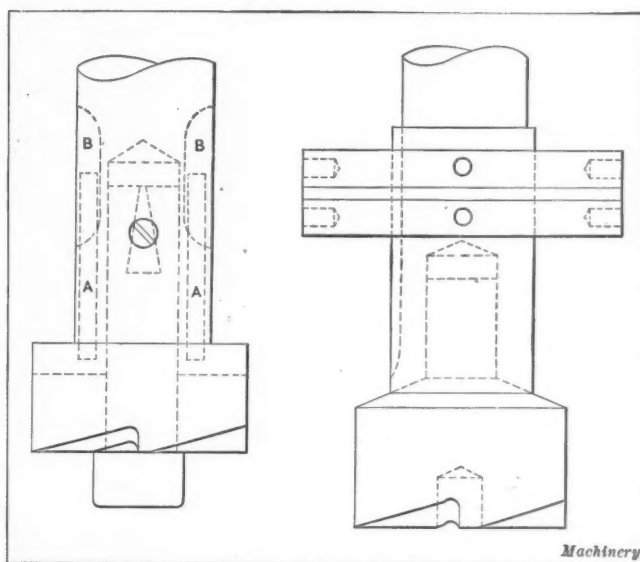


Fig. 6. Form of Spot-facing Tool that is easily repaired

Fig. 7. Tool for spot-facing Surfaces drilled and reamed in a Jig

point set-screw. The teeth terminate in a liberal fillet and the angle is comparatively slight. This is essential on rapid production work, where tools are worked to the limit to avoid undue breakage. The pilot can be protected from undue wear by casehardening, if machine steel is used. Boiling in cyanide for fifteen minutes will produce a case deep enough to withstand several weeks of constant use. The cutter should be made of high-speed steel if the material to be machined is cast iron or steel; for brass and aluminum, how-

ever ordinary tool steel may be used, especially since the war has forced the price of high-speed steel to an almost prohibitive mark. If an accurate face is desired, the hole in the cutter should be finished after hardening by grinding or lapping, and the teeth should be backed off by locating the piece from the hole. If only a fair degree of accuracy is called for, however, the teeth can be backed off with a file before hardening, and in this case no grinding is necessary until the teeth become dull through use.

Occasionally, it is convenient to have spot-facing tools that are interchangeable, as shown in Fig. 1. Here the shank is drilled and reamed to accommodate the pilot, which is held in place by a set-screw, while the cutter is fastened to the shank by another set-screw. By providing several pilots and cutters, quite a variety of work can be taken care of without making complete tools for each hole. The shank can be left soft, but the cutters and pilots should be finished by grinding after hardening. It is not necessary to make the pilots of tool steel, as ordinary machine steel, casehardened by packing in bone dust, gives equally good results. The tool shown in Fig. 2 has a removable pilot, but inasmuch as the shank and cutter are made integral it is an expensive form of construction. For small sizes, however, say one inch in diameter and smaller, this form is often used. In sharpening, the pilot is removed and the tool is located by the shank.

¹Address: 435 Harvard Place, Indianapolis, Ind.

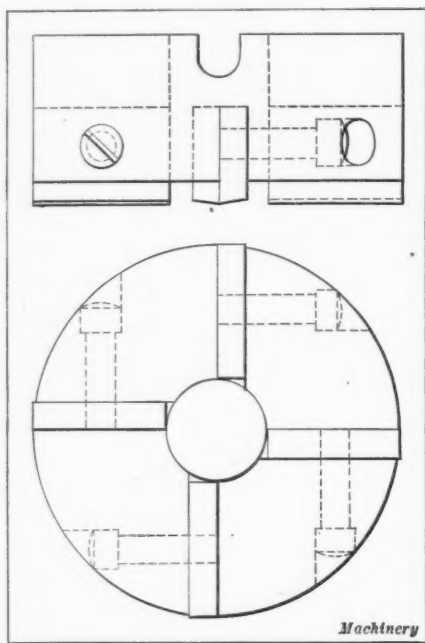


Fig. 8. Spot-facing Tool with Inserted Teeth

A unique form of spot-facing tool is shown in Fig. 6. The cutter is driven by two pins *A* that are a driving fit in the shank. Slots *B* are milled with a Woodruff key cutter for the purpose of driving out the pins when necessary. When the pins shear off, which sometimes happens, all that is necessary is to remove the pieces that have been cut off and drive the pins down slightly; the cutter is then ready for use. With the form shown in Fig. 3, it would be necessary to remill the end of the shank, which would take at least an hour's time, whereas with the pin design the operator can repair the damage in a few minutes. For this reason the pin form of tool is extensively used.

Comparatively large spot-facing tools, from two inches in diameter upward, are often made with inserted teeth as shown in Fig. 8. The cutter-head can be made of machine steel while the cutters can be of either tool or high-speed steel according to the nature of the work. The cutters are held in place by fillister-head screws. As the cutters seat firmly on the bottoms of the slots provided for them, one screw suffices to hold each cutter in place. The wear on the cutter-head is slight, and it should last indefinitely; when the cutters have been ground until they have become useless, they can be replaced at slight cost.

It is often advisable to spot-face surfaces on work that is drilled and reamed in a jig, in which case it is a good plan to dispense with the pilot, guiding the tool by means of a supplementary bushing inserted in the jacket bushing. As shown in Fig. 7, the cutter is held to the shank by means of a coarse-threaded screw machined to fit rather loosely, as the tool is centered by the bevel. The two collars are threaded to the shank and are for the purpose of adjusting the depth of cut as occasion requires; as they bear on the top of the bushing they should be hardened and ground true. A cutter of this kind could, of course, be guided by a pilot, but as spot-facing tools are generally broken by the pilot galling up it is a good plan to eliminate this feature when possible. In order to save the expense of an extra bushing, these tools are sometimes run directly in the jacket bushing, but this is poor economy, as the bushing is soon worn oversize, and the accuracy of the jig is impaired. The tools described are among the simple things that are often lacking, even in many well organized shops, but a little attention to simple tools often leads to efficient results, thus aiding materially in cutting down the cost of production.

* * *

In order to prevent the misappropriation of foreign trademarks, the president of Costa Rica has ordered that no trademark that is well known in the country, because of the advertising or the sale of the trademarked articles, shall be registered unless authority to apply for such registration is proved.

A good design is illustrated in Fig. 3. The pilot locates the cutter, being fastened by a set-screw, while the strain of driving is taken by two projections, milled on the end of the shank, which fit a slot in the top of the cutter. This is a practical form of tool if properly made. As the illustration shows, the slot in the top of the cutter terminates in a half-round section; this form is essential, for a sharp corner at this point would be very likely to result in a fracture.

THE GRINDING WHEEL¹

The electrochemist speaks of the abrasive wheel and the automobile manufacturer of the emery wheel, but the manufacturer thinks that neither of these words adequately describes his product, and so has adopted the term "grinding wheel." This term is here restricted to those wheels that are composed of two main constituents: the abrasive and the bond, or the substance that holds the particles of abrasive together. The commercial method of classifying grinding wheels is by the kind of bonding material used.

The most important type is the vitrified wheel. The bonding material in this type is composed of various kinds of clay mixed according to definite, secret formulas. Weighed amounts of the abrasive and the bond and a measured amount of water are stirred together in a mixing kettle for a certain length of time and then the mixture is drawn off from the bottom of the kettles into molds and allowed to dry. When dried, the wheels are taken to the shaving department, where they are turned to the approximate dimensions and shape called for by the order.

A kind of vitrified wheel, known as pressed wheel, is made by the pressed process. In this case, only enough water is added to the bonding clays to make the particles stick together to a slight degree. The abrasive and bond are mixed in kneading machines and are then placed in an iron mold and subjected to pressure by powerful hydraulic presses. The pressure applied depends on the grade of hardness desired. These wheels do not need shaving. The next operation is the heat-treatment, in which the wheels are subjected to a heat that will properly vitrify and mature the bond; the highest temperature reached is about the melting point of steel. The length of time required for heating, the length of time during which the wheel is subject to high heat, and the cooling period must be carefully controlled.

In silicate wheels, the bonding material is a commercial grade of silicate of soda, commonly known as water-glass, to which certain chemicals are added to make the bond waterproof. A weighed amount of the grain and a measured amount of the bonding material are placed in long cylinders, which are slowly revolved, end for end, until a uniform mixture is obtained. The mixed mass is placed in an iron mold of the approximate dimensions called for by the order and rammed into place by hand or air hammers. The wheel is then baked.

The name elastic wheel is derived from the fact that the bonding material has quite a degree of elasticity. The bond is of organic nature, the most satisfactory material being shellac, to which certain chemicals are added to facilitate hardening in the baking and also to make the wheel waterproof. Weighed amounts of the grain and the bond are thoroughly mixed and then dumped into large shallow pans and allowed to cool, thus becoming brittle. This brittle cake of abrasive and bond is broken into small pieces and then put through rolls that break the mass into the individual grain. The rolls do not fit close enough, however, to reduce the size of the grain, the idea simply being to produce a mass composed of loose grains, each of which has a coating of shellac. The material is then placed in an iron mold the approximate shape of the wheel, heated and then subjected to pressure. The amount of pressure depends on the degree of hardness desired. The mold and mass are again placed in a steam box and heated until the bond becomes permanently hard.

In vulcanized wheels, the bonding material is rubber, and their manufacture is practically like that of any other hard-rubber product. A weighed amount of the very best grade of crude rubber, the right proportion of sulphur, and a weighed amount of grain are thoroughly mixed by numerous passes in a vertical direction. After a uniform mixture is obtained, the mass is passed through a set of rolls that passes the material in a horizontal direction. It is then rolled down to the required thickness, cut to the required diameter, and a hole of the required diameter is cut in the center. The next operation is vulcanizing, which does not differ from the vulcanizing of any other rubber product.

¹Abstract of a paper by R. G. Williams read before the American Electrochemical Society, in Detroit, May, 1917.

The next operation in the making of the wheels is that of truing, or bringing the wheels to the dimensions called for on the order. The wheels are mounted in a three-jaw chuck, revolved, and special tools resembling an emery-wheel dresser are brought up against the side of the wheel. In order to bring the wheels to the desired diameter, they are firmly held on a revolving arbor and the dressing tool passed back and forth across the face, gradually reducing the wheel to the desired size. For fine wheels that must be carefully shaped on the face, a diamond is securely mounted in a fixture and slowly passed across the face of the wheel. Light cuts only are taken so as not to crack and destroy the diamond.

The bushing, as it is termed, consists of lead or a babbitt. The wheel is allowed to rest on its side in a three-jaw chuck and is carefully centered; then a steel arbor from 0.002 to 0.005 inch larger than the desired hole in the wheel is placed in the center hole in the chuck and the lead poured around the arbor. When the lead has solidified, the wheel is removed from the chuck and the arbor is carefully driven out with a soft hammer. The bushing is then trimmed, so that it is not quite flush with the sides of the wheel; this is to provide clearance so that when the wheel is mounted on the machine there will be no possibility of stress being concentrated at the hole of the wheel.

In the next operation, the speed test, the wheel is revolved at a speed higher than that recommended for its operation, in order that the manufacturer may know that his product goes out with a sufficient factor of safety. The testing speed for wheels is 9000 surface feet per minute, except for those of organic bonds, when the test speed is higher. Since wheels are recommended to operate at about 5000 surface feet per minute, this gives a factor of safety, based on the squares of these speeds, of between 3 and 4. A careful record of every test is kept; and before these records are filed, the men that keep them are required to appear before a justice of the peace and swear that their statements are true.

Grinding Characteristics of Various Abrasives

Probably the most important physical property of an abrasive is hardness. Other properties, such as toughness and ability to resist shock, are also important, but knowledge of the art of grinding has not advanced sufficiently for us to state definitely the relative importance of the different physical characteristics; that is, we cannot state on which of the properties the grinding action of the abrasive most depends. It is known that the artificial abrasives are harder than corundum but not so hard as diamond. It is hard to determine differences in the hardness of artificial abrasives, although it is known that carbide-of-silicon abrasives are harder than aluminous abrasives.

When a grinding wheel containing a certain abrasive satisfactorily grinds very tough material, it is said to possess considerable toughness. Actual experience has shown that when materials of low tensile strength, such as cast iron, brass, bronze, etc., are ground, carbide of silicon, which is hard but relatively weak, is more efficient than aluminous abrasives. On the other hand, when grinding materials of high tensile strength, ranging all the way from medium carbon to the high-speed steels, aluminous abrasives give better satisfaction.

Precision Grinding Machines

The word "precision" is used to designate a type of grinding machine, because these machines must be capable of producing work of great accuracy. The art of precision grinding has advanced rapidly during the past few years and the demand of the automobile manufacturer should receive credit for producing most of the advance. Only a few years ago anyone advocating the accurate grinding of shafts five or six inches long without table or wheel traverse would have been condemned as too visionary; this step in the art has long since been passed. It is now possible to grind more than one diameter at one time with one wheel; this is an outgrowth of the use of very wide wheels taking extreme cuts without any traverse of the table or the wheel.

A machine using a very wide wheel, say ten or twelve inches, must be very rigid as well as capable of producing re-

finer work. Imagine the forces present when a wheel weighing 150 or 200 pounds revolves on a spindle, in plain bearings, at 1000 to 1200 revolutions per minute. This spindle must be kept in perfect alignment so that the face of the grinding wheel will produce an absolutely straight cylinder, and there must be ample weight in the base of the machine and in the wheel-slide to absorb all vibration caused by the revolving mass. Another factor that must be borne in mind is the resistance offered when the wheel is brought in contact with the work, as small particles of a very hard material are removed at an extremely rapid rate. The spindle bearings must be so adjusted that the boxes will be quite hot when the machine is in operation; in fact, a temperature of about 140 degrees F. is desirable.

Limits of 0.0005 inch on the work being ground are very common; those of 0.00025 inch are quite common; and in some cases less than 0.00025 inch is demanded. When the work is reduced 0.00025 inch, the massive slide carrying the wheel-spindle and the grinding wheel moves forward only one-half this distance, or 0.000125 inch. If it were possible to split a piece of tissue paper into twelve thicknesses, the thickness of one piece would represent the motion of the wheel-slide when the grinding wheel removes 0.00025 inch from the work, and this accuracy must be maintained not only where very small cuts are taken, but also when the object is to grind off as many cubic inches per minute as possible.

* * *

CONFERENCE WITH GOV. WHITMAN

A conference between Governor Whitman of New York State and trade press editors and publishers was held in Albany, July 25, at the Executive Mansion. The conference is likely to have bearing on some of the relations of the state executive to the various industries represented. Questions of transportation, food control, marketing, conservation of coal and lumber, relations of manufacturers and labor, the importance of exempting machinists and toolmakers and others vitally necessary to the prosecution of this war with machinery, were discussed at some length. A committee of five editors has been appointed to give Governor Whitman the expert advice they are able to furnish because of personal knowledge and connections that enable them to draw from sources of information which may be of service in the prosecution of war.

* * *

The new color scheme of signal indications, by which white lights will be eliminated altogether, was placed in effect on all lines of the Pennsylvania Railroad east of Pittsburgh, June 28. Nearly a year of preparatory work was required to make the change possible. Great difficulty was experienced in obtaining deliveries of materials, owing to the war conditions. The decision to eliminate white from the signal color scheme was reached on account of the increasing use of white lights in buildings, driveways, roads and streets close or adjacent to the railroad's right-of-way. Under the new plan, green will replace white for "clear" or "proceed." "Caution" will be indicated by yellow. Red will mean "stop," as heretofore. The glasses in all the semaphore signals and the following devices have been altered to conform to the new plan of color indication: marker lights on the rear of passenger and freight trains; switch lamps and targets; markers for track tanks; "slow" signs; "resume speed" signs; and hand lamps at interlocking and block signal stations.

* * *

An elaborate electrical sign has recently been erected by the Rice Leaders of the World Association in a prominent position overlooking upper Broadway in New York City. The firms in the machinery and tool field whose products are advertised by flashes on this sign are the Billings & Spencer Co., Hartford, Conn.; the Nicholson File Co., Providence, R. I.; and the L. S. Starrett Co., Athol, Mass. The names and products of the various firms that are members of the Rice Leaders of the World Association are flashed upon the sign in rapid succession. The upper part of the sign is composed of the elaborate coat-of-arms or emblem of the Association in colors.



ACCURACY—The First Requirement,

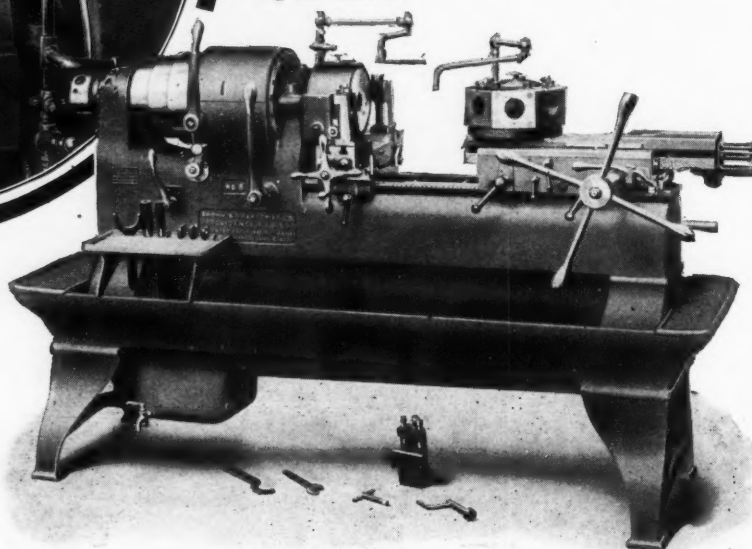
"BROWN & SHARPE

For Steady, Fast,



**The Twist of a Wrench Adjusts
the Chuck of *This* Screw Machine
to Any Size**

Not only does this feature of B & S Nos. 4 and 6 Wire Feed Screw Machines make a material saving on the first cost, but saves time as well as dollars throughout their years of efficient service because no time is lost in adjusting special chucks or in searching for collets.



**BROWN
&
SHARPE**
*Heavy
Wire Feed
Screw
Machines*

Offices:

NEW YORK, N. Y., 20 Vesey St.
PHILADELPHIA, PA., 652-654 The
Bourse. CHICAGO, ILL., 626-630
Washington Blvd. ROCHESTER,
N. Y., 415 Chamber of Commerce Bldg.
SYRACUSE, N. Y., Room 419 Uni-
versity Block. PITTSBURGH, PA.,
2538 Henry W. Oliver Bldg.

Canadian Representative:

MONTREAL, TORONTO, WINNIPEG,
CALGARY, VANCOUVER, ST. JOHN,
SASKATOON, The Canadian Fair-
banks-Morse Co., Ltd.

A simple adjustment, as shown in cut above, similar to the method used in adjusting the jaws of a universal chuck, is all that is necessary to handle round, square or hex stock of any size within capacity of machine. It also automatically compensates for any slight variation in the size of a bar.

This automatic-chuck feature together with

Three-lever Centralized Control

practically eliminates all lost motions.

After tools are set chuck is opened and stock advanced by the slight throw of a handy lever. The return of this lever to its original position closes and locks the chuck.

A second lever, also on the headstock, is employed for starting, stopping and changing speeds while the simple movement of a third lever, close by, changes feed of turret slide in conjunction with a lever just behind the pilot wheel of turret slide which is manipulated with the right hand in connection with the handling of pilot wheel to bring tools up to cut.

Other reasons why your bar work should be handled on these machines—reasons that spell economy and increased production—are explained in detail in our Catalog 21-G. Your request will bring a copy.

Brown & Sharpe Mfg. Co.,

HANDINESS—An Attribute of Every B & S Product

EQUIPPED"

Quality Production

An Increase in Production and Quality With a Corresponding Decrease in the Scrap Heap

naturally follows the use of Brown & Sharpe Tools. The confidence that encourages competence is inspired by the use of these handy, accurate tools and is soon reflected in the high degree of efficiency their use promotes.

Numbering over a thousand different varieties, they

Cover Thoroughly Every Precision-Tool Requirement

and represent a development covering over half a century.

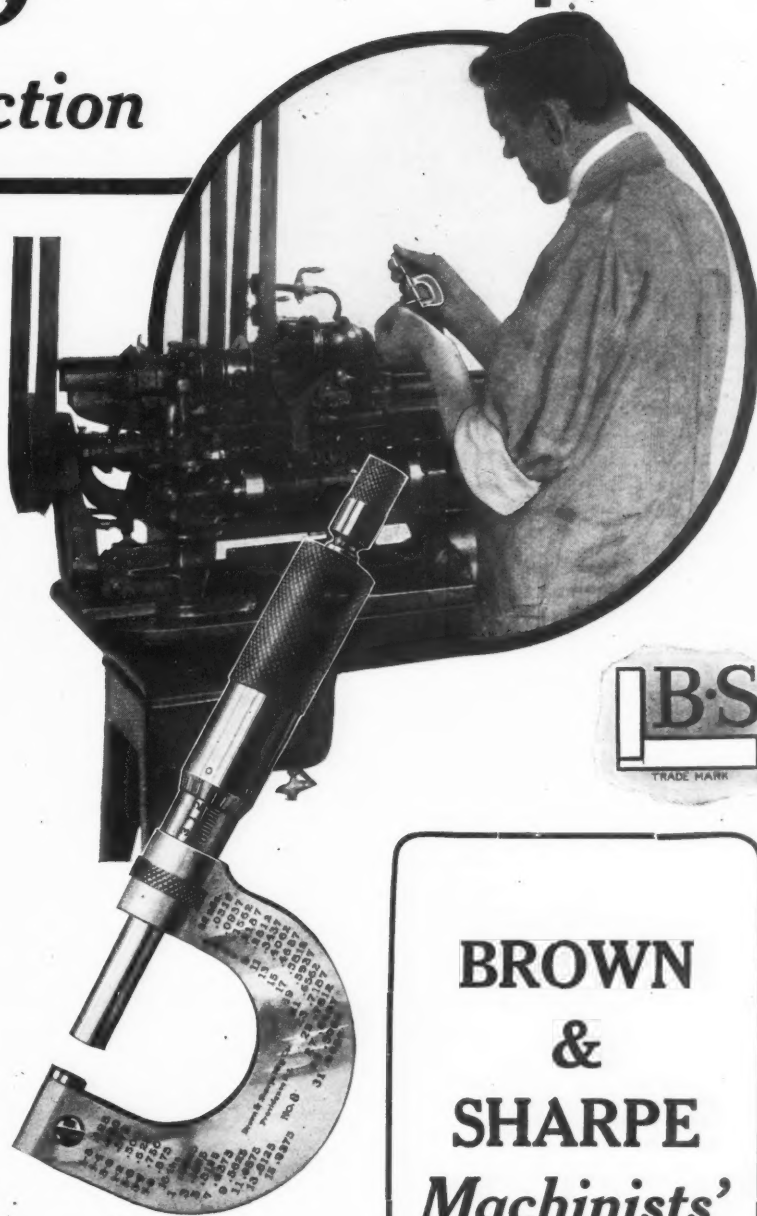
Practically every variety of measuring tool is used in our own shops in the manufacture of our extensive line of machinery, and our small-tool designers have worked with the advantage of first-hand information as to the needs of the man in the shop.

Every care is taken that the highest quality of workmanship be maintained, resulting in a line of machinists' tools that is world-known for its uniform quality. Not only the kits of your tool-makers and machinists but

Your Tool Cribs Should be "Brown & Sharpe Equipped"

If interested in steady, fast, quality production you should have a copy of our Catalog 27. Send for your copy today.

Providence, R. I., U. S. A.



BROWN & SHARPE Machinists' Tools

Representatives:

BALTIMORE, MD., Carey Machinery & Supply Co. CINCINNATI, O., INDIANAPOLIS, IND., The E. A. Kinsey Co. SAN FRANCISCO, CAL., Pacific Tool & Supply Co. CLEVELAND, O., DETROIT, MICH., Strong, Carlisle & Hammond Co. ST. LOUIS, MO., Colcord-Wright Machinery & Supply Co. SEATTLE, WASH., Perine Machinery Co. PORTLAND, ORE., Portland Machinery Co.

LESSONS FROM BRITISH EXPERIENCE

In 1915, the British Minister of Munitions appointed a committee to consider and advise on questions of industrial fatigue, hours of labor, and other matters affecting the personal health and physical efficiency of workers in munition factories and workshops. This committee, after making a careful investigation, has made the following suggestions and recommendations with the purpose of securing maximum output over a period of months, or even years, and at the same time safeguarding the physical efficiency of the workers:

If the maximum output is to be secured and maintained for any length of time, a weekly rest period must be allowed. Except for short periods, continuous work is a mistake and does not increase the output. On economic and social grounds, this weekly rest period is best provided on Sunday. The foremen and the higher management even more certainly require definite periods of rest. They have never spared themselves; they carry a heavy burden of responsibility and cannot be replaced. It is of primary importance, in the interests of the nation, that they should be allowed that rest which is essential to the maintenance of their health.

The objections to overtime, briefly stated, are: It is likely to impose too severe a strain upon the workers, which adversely affects the rate of production and quality of output during the whole period of work as well as during the hours of overtime. It frequently results in a large amount of lost time, which is attributed to the workers becoming exhausted and taking a rest, and also to sickness. It imposes a serious strain upon the management, the executive staff, and foremen, since these persons cannot take days off like the ordinary worker. It is likely to curtail unduly the period of rest and sleep available for those who have to travel long distances to and from work, a matter of special importance in the case of young persons. The fatigue entailed increases the temptation to indulge in the consumption of alcohol.

Admitting that overtime must continue, for adult male workers the average weekly hours (exclusive of meals) should not exceed 65 to 67, including overtime. It may be desirable to differentiate to some extent between different kinds of work and to fix a rather low limit of hours for work requiring close individual attention. Where practicable, the overtime should be concentrated within three or four days in the week, which should preferably not be consecutive. Where overtime is necessary, it is specially important that there should be no Sunday work. The committee feels that the need for overtime among

women and girls is much less pressing than it is for men, and should be abandoned in favor of shifts.

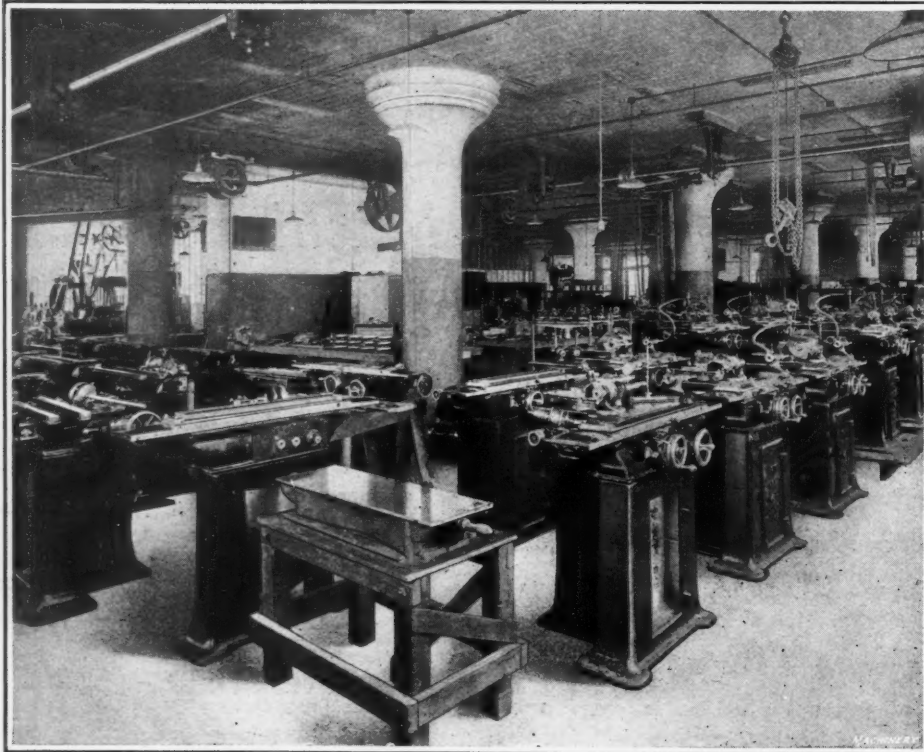
Although work on shifts involves night work, night work is not a good thing in itself because it is uneconomical. Though wages are paid at a higher rate, the rate of output, more particularly during the last two or three hours of a twelve-hour shift, is generally lower. Supervision is frequently unsatisfactory. Conditions of lighting are seldom as good as in the daytime and make fine work more difficult. Workers experience great difficulty in sleeping by day. The unfamiliar meal hour makes it difficult for the workers to consume substantial food, and digestion is likely to be upset.

As a method of speeding up production, the committee recommends the careful regulation of rest periods. It has been found that the operatives, if left to themselves, take rests at irregular and often unsuitable times; hence it is much better for the rest periods to be chosen for them. For instance, a ten-minute period in the middle of the morning and the afternoon, during which the operatives remain at their machines, but have tea or other nutriment brought them by boys or by traveling canteens, has been found a valuable aid to output. Some kinds of work need longer and more frequent rest periods than others; this is determined only by experience.

The committee found that the munition workers, in general, have been allowed to reach a state of reduced efficiency and lowered health, which might have been avoided without reduction of output by attention to the details of daily and weekly rests. The signs of fatigue are even more noticeable in the case of managers and foremen.

The committee calls attention to the fact that bad lighting affects output unfavorably by making good and rapid work difficult, and also by causing headaches and other effects of eyestrain. The difficulties of supervision are further increased. The essentials of good lighting are: adequacy; a reasonable degree of constancy and uniformity of illumination over the necessary area of work; the placing or shading of lamps so that light does not fall directly on the eye of the operator when engaged at his work or when looking horizontally across the work-room; the placing of lights so as to avoid the casting of extraneous shadows on the work. The committee also calls attention to the need of special measures to prevent undue strain upon the eyesight or to reduce the liability to accidents to a minimum. It suggests that the eyesight of operatives employed on close work be tested and the persons supplied with glasses when necessary; it also suggests guarding the eyes by the use of goggles.

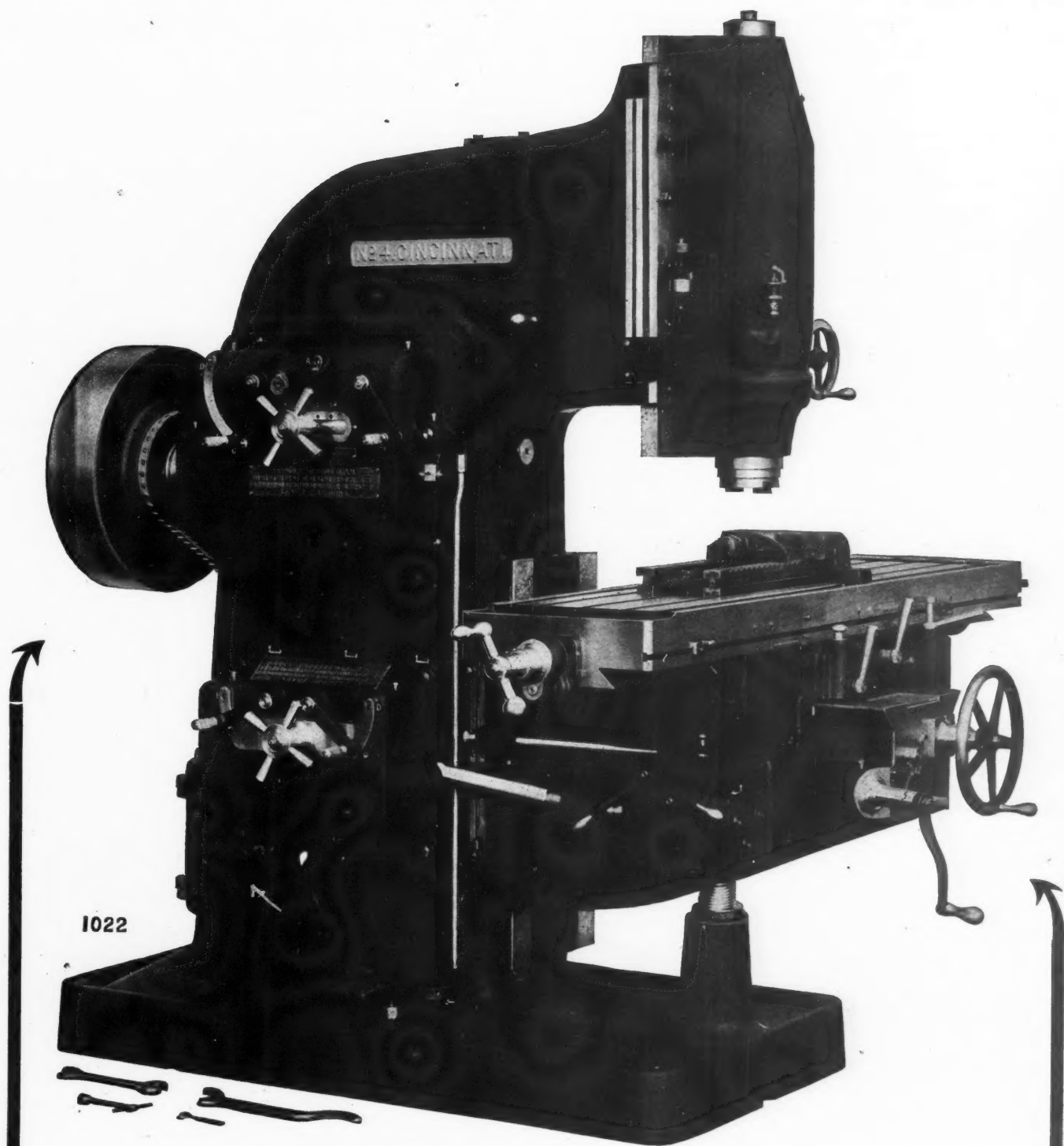
* * *



Assembling, erecting and testing Ott No. 1 Universal Grinding Machines

The illustration shows the floor of the Ott Grinder Co. in the Industrial Building, Indianapolis, Ind. The view is of interest, as it gives an idea of the rapid development of one comparatively small manufacturer who started a few months ago to build the line of cylindrical grinding machines acquired by purchase from the Modern Tool Co. of Erie, Pa. The growth of the business reflects the fact that the cylindrical grinding machine is no longer regarded as a refinement for the use of toolmakers only, but is rapidly becoming an indispensable machine tool to many concerns that found no use for it in their machine shops a few years ago. The view shows thirty No. 1 universal grinding machines in the various stages of assembling, erecting and final testing under belt. These are part of fifty machines put through in one lot. The first machine in the front row is being tested for accuracy, a Brown & Sharpe indicator being used for testing the alignment of both wheel-spindle and headstock.

Cincinnati Verticals



Unusual Spindle Power.
Heat Treated Alloy Steel Hardened Gearing.
Massive Spindle Head Construction.
Handy—Can mill around a rectangle without
stopping feed or speed.

These are some reasons why you should use Cincinnati Verticals

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI, OHIO, U. S. A.

PERSONALS

B. H. Blood has been appointed general manager of the Pratt & Whitney Co., Hartford, Conn., following the resignation of B. M. W. Hanson.

L. A. Larsen was appointed comptroller, effective July 1, at a recent meeting of the board of directors of the American Locomotive Co., New York City.

B. Orum Andresen has joined the engineering staff of Aall & Co., of Tokyo, Japan, the Japanese agents for the American Steel Export Co., Woolworth Bldg., New York City.

Charles H. Purdy, superintendent of the Dalton Machine Co., of New York City, has resigned to engage in the designing and building of special machinery, with offices at 103 E. 125th St., New York City.

H. L. Paulus, R. G. Ferguson, and F. L. Graf, for many years connected with the Baird Machinery Co., of Pittsburg, Pa., have resigned and joined forces with the J. S. Miller Machinery Co., of Pittsburg.

B. M. W. Hanson, general manager of the Pratt & Whitney Co., Hartford, Conn., has resigned, and has been made vice-president and general manager of Colt's Patent Fire Arms Mfg. Co. of Hartford.

Albert P. Weigel, superintendent and general manager of the Superior Machine Tool Co., Kokomo, Ind., has resigned and organized the Weigel Machine Tool Co., Peru, Ind., to manufacture machine tools.

Edgar N. Dollin, organizer and president of the Acme Die-Casting Corporation, Brooklyn, N. Y., has sold his holdings in the company and retired from active management. Mr. Dollin was formerly secretary of the Doehler Die-Casting Co., and president of the Kalak Water Co. He has had a wide business experience as a lawyer and as a manufacturer. His new activities have not been announced.

R. M. Klein has been appointed sales manager of the International Oxygen Co., with headquarters at the company's main office at 115 Broadway, New York City. Mr. Klein brings to his new position technical training, and experience as an engineer in the United States government employ, as salesman and sales manager of the Diehl Mfg. Co., and as manufacturers' representative handling a number of mechanical lines.

R. J. Doty, who for the last three and one-half years has been in charge of the steel foundry of the Isaac Johnson Co., Spuyten Duyvil, N. Y., has resigned his position to become associated with the Sivyer Steel Casting Co., Milwaukee, Wis. The company is enlarging its plant and installing an additional three-ton electric furnace to take care of its growing business among the motor truck, tractor, and general machinery manufacturers.

George A. Willard, for many years a manufacturer of lathes in Cincinnati, Ohio, has sold the Willard Machine & Tool Co. to G. Mattman and Thomas L. Bratten. Mr. Mattman was formerly European representative of the Cincinnati Milling Machine Co., and Mr. Bratten held an executive position with the Employers' Liability Corporation, and is well known in the trade. Mr. Willard will retire from business and take a much needed rest at his summer home in Michigan.

F. H. Tackaberry, general agent of the American Steel Export Co., Woolworth Bldg., New York City, sailed July 7 for South America. Mr. Tackaberry will visit the principal South American cities—Rio de Janeiro, Sao Paulo, Buenos Aires, Montevideo, La Plata, Rosario, Valparaiso, Santiago, etc., his object being primarily to collaborate with the company's factory agents and acquaint them with the market conditions in the United States for iron and steel and engineering and contracting.

OBITUARIES

H. C. Mather, president of the Moore Oil Co., Cincinnati, Ohio, was drowned June 26 in Lake Superior near Calumet, Mich.

Casimir von Philp died July 5 at Ocean City, N. J., aged sixty-four years. He was born in Sweden, but came to the United States nearly forty years ago. Since 1890, he was connected with the Bethlehem Steel Co., at Bethlehem, Pa., for a considerable period as chief engineer and recently as manager of the machinery department. As an engineer, his career was marked by unusual ability and originality. His inventions included improvements in rolling mills and special features of heavy forging equipment produced at the Bethlehem works. He was a member of the American Society of Mechanical Engineers, the American Society of Swedish Engineers, and the Engineers' Club of New York. He was also recently appointed a member of the John Ericsson Memorial Commission.

COMING EVENTS

August 30—Monthly meeting of the Rochester Society of Technical Draftsmen, in Rooms 131-137, Sibley Block, 328 Main St., E., Rochester, N. Y. O. L. Angevine, Jr., secretary, 837 Genesee St., Rochester.

August 30-September 1—Ninth annual convention of the American Railway Tool Foreman's Association, Chicago, Ill.; Sherman Hotel, headquarters. C. N. Thulin, secretary-treasurer, 935 Peoples Gas Bldg., Chicago, Ill.

September 10-15—Annual convention of the National Safety Council, New York City; Hotel Astor, headquarters. Marcus A. Dow, president, Grand Central Station, New York City.

September 10-15—Exposition of safety appliances at the Grand Central Palace, New York City, under the auspices of the American Museum of Safety, 18 W. 24th St., New York City. Arthur H. Young, director.

September 25-28—Twenty-second meeting of the American Foundrymen's Association, Boston, Mass.; Copley-Plaza Hotel, headquarters. The registration booth will be in the Mechanics' Bldg., where the exhibition of foundry and machine shop equipment and supplies will be held. A. O. Backert, secretary-treasurer, 12th and Chestnut Sts., Cleveland, Ohio.

September 27-29—Informal congress and reunion of American and Canadian engineers and architects of Norwegian birth or descent in Chicago at Chicago Norske Klub, 2346 N. Kedzie Blvd., Logan Square, Chicago, Ill.

SOCIETIES, SCHOOLS AND COLLEGES

Brown University, Providence, R. I. Circular on the new course in engineering containing illustrations of the laboratory equipment and statement of the requirements for the degree of bachelor of science in engineering.

Polytechnic Institute of Brooklyn, Brooklyn, N. Y. Pamphlet outlining the evening courses offered by the institute in engineering, chemistry, physics, mathematics, drawing, history, economics and languages. The season 1917-1918 begins October 1 and continues until the courses are completed.

Y. M. C. A. Industrial Department, 124 E. 28th St., New York City. Pamphlet outlining the or-

ganized industrial extension work undertaken by the City Association Among Industrial Workers for the benefit of workers in factories and shops throughout the country. The work comprises educational, social, physical, religious and general activities.

Electric Power Club at its annual meeting held in Washington, D. C., June 11-12, elected C. L. Collens, of the Reliance Electric & Engineering Co., president; F. S. Hunting, of the Fort Wayne Works of the General Electric Co., vice-president; and C. H. Roth, of Roth Bros. & Co., secretary-treasurer. A resolution tendering to the government the use of the manufacturing plants of the members and offering the services of the committees was passed.

NEW BOOKS AND PAMPHLETS

Constitution of the United Nations of the Earth. By Edgar D. Brinkerhoff. 22 pages, 6 by 9 inches. Published by the Pamphlet Publishing Co., Fall River, Mass.

This remarkable document is virtually a paraphrase of the Constitution of the United States adapted for the united nations of the earth as envisioned by the author.

Oxy-acetylene Welding Practice. By Robert J. Kehl. 105 pages, 5½ by 8¼ inches; 111 illustrations. Published by the American Technical Society, Chicago, Ill. Price, \$1.

The work is a practical presentation of the processes of welding, cutting and lead burning, with special attention to welding practice for steel, cast iron, aluminum, copper and brass. It is illustrated with many examples showing how to handle the torch and to prepare work for welding. Examples of automobile repair are included, thus making the work of special interest to owners of garages and others concerned with motor car repairs.

How to Make High-pressure Transformers. By F. E. Austin. 46 pages, 4½ by 7½ inches; 21 illustrations. Second edition. Published by Prof. F. E. Austin, Box 441, Hanover, N. H. Price, 65 cents.

The first edition of this book was published in 1914. It is essentially a work on experimental electrical engineering written with regard to the well-known fact that to learn things we must do things. The student is instructed in the theory of high-pressure transformer design by designing and making a transformer. The work is both practical and technical, but not too highly technical to place it beyond the comprehension of men having a good high school education. It contains data

that should be of use to engineers who wish to brush up on the principles of electrical engineering. Machine Drawing. By Ralph W. Hills. 22 pages, 6 by 9 inches; 119 illustrations. Published by the McGraw-Hill Book Co., New York City. Price, \$1.

Many books have been published on mechanical drawing; these may be divided into two general classes: first, those that teach drawing for drawing's sake, and, second, those that teach mechanical drawing for the purpose of making the student a practical draftsman or to give him the knowledge that will enable him to make use of mechanical drawing to the best advantage. This work is an excellent example of the second class. The material is the first half of the instruction papers in machine drawing, as developed and used by the Extension Division of the University of Wisconsin. The subject matter deals with instruments and materials, principles of mechanical drawing, screws and screw fastenings, sections, technical sketching, tracing, assembly and detail drawings. Some useful data are included which afford good examples for practice in making up tables. The work is one that we recommend to students whether in school or engaged in home study.

Locomotive Valves and Valve Gears. By Jacob H. Yoder and George B. Wharen. 272 pages, 6 by 9 inches; 274 illustrations. Published by D. Van Nostrand Co., New York City. Price, \$3 net.

This work is, we believe, the first special treatise on valves, valve gears and valve setting published which may be recommended to railway mechanics as a practical guide for locomotive valve setting and a treatise on the common and uncommon types of valve gears. It explains the construction and action of the plain slide valve, the piston valve, and the valve gears used to operate them, as applied to locomotives, and is based on notes used in schools for apprentices on the Pennsylvania Railroad. The authors state in the preface that the book had been prepared to meet the general desire among railroad shop men to acquaint themselves with the valves and valve gears applied to modern locomotives, and to master the principles of valve motion as a preparation to valve setting. Valve motion and valve setting have always appeared to many shop men as more or less of a mystery, and it is the aim of the work to enable those interested to acquire first-hand knowledge. The subject matter is given in seven chapters, the contents of which are as follows: Locomotive Valves and Valve Gears; Stephenson Valve Gear; Walschaerts Valve Gear; Baker Locomotive Valve Gear—Southern Locomotive Valve Gear—Joy Valve Gear—Young Locomotive Valve Gear, and Reverse Gear—Gooch Stationary Link—Allen Valve Gear—Effects of Altering the Valve and Its Events; Locomotive Valve Setting; Steam Engine

The LUCAS

(OF CLEVELAND)

“PRECISION”

BORING, DRILLING AND

MILLING MACHINE

ALWAYS GOOD

and as time goes on

ALWAYS BETTER

LUCAS MACHINE TOOL Co.,



CLEVELAND, O., U.S.A.

Indicator and the Indicator Diagram. The illustrations and directions for valve setting leave little to the imagination, the steps pursued by the practical valve setter in securing the data required for adjustment of the eccentrics and eccentric rods being clearly and specifically described. The book is one that we heartily recommend to all railway students and others interested in locomotive valve motion.

NEW CATALOGUES AND CIRCULARS

Warner Hammer Co., Cromwell, Conn. Price list of Warner hammers and edge tools.

Metalwood Mfg. Co., Detroit, Mich. Bulletin B-44 of the Metalwood inverted type adjustable forming press, No. 121.

Metalwood Mfg. Co., Detroit, Mich. Circular B-53 of the Metalwood No. 79 hydro-mechanical banding press for banding shells from 3 to 5 inches.

Standard Alloys Co., Pittsburg, Pa. Pamphlet entitled "Uranium in Steel," presenting comparative tests of uranium and other high-speed steels.

Day & Zimmermann, Inc., Philadelphia, Pa., has issued a bulletin showing typical industrial plants throughout the country constructed by this company.

Link-Belt Co., Chicago, Ill. Book 258 entitled "The Ideal Drive for Textile Machinery," illustrating Link-Belt silent chain installations in textile mills.

Cummings Ship Instrument Works, Boston, Mass. Bulletin descriptive of the Gary-Cummings torsion meter for determining the horsepower transmitted by shafts.

Hisey-Wolf Machine Co., Cincinnati, Ohio. Bulletin 1403, describing "Hisey" portable electric surface grinders, made for use with either direct or alternating current.

Oakley Chemical Co., 26 Thames St., New York City. Information sheet 857 on munitions manufacture, illustrating uses of "Oakite" cleaning and cutting compounds.

Stanley Belting Corporation, 32-40 S. Clinton St., Chicago, Ill. Circular of Stanley woven cotton belting, made in single, double and triple thicknesses and in all widths up to forty-two inches.

Peter A. Frasse & Co., Inc., 417 Canal St., New York City. July stock list giving sizes in stock ready for immediate shipment of Frasse electric tool steel, drill rods, steel shafting and strip steel.

Messer Mfg. Co., 117-121 N. 7th St., Philadelphia, Pa. Catalogue of Messer portable oxy-acetylene apparatus for welding and cutting; regulating valves, welding blow-pipes and acetylene generators.

Nagle Corliss Engine Works, Erie, Pa. Bulletin 27, illustrating and describing Nagle-Corliss Class A-E and B-E steam- and power-driven air compressors with capacities from 3 to 8000 cubic feet of free air per minute.

Sunderland Machinery & Supply Co., 1006-1010 Douglas St., Omaha, Neb. Circular of the Fox arbor press No. 4, having capacity for work 19 inches diameter. The movement of the ram is 17½ inches and the leverage 60 to 1.

Sprague Electric Works of General Electric Co., 527-531 W. 34th St., New York City. Bulletin 48923 of Type W, one- to six-ton electric hoists, giving specifications, dimensions, and weights, and showing a few uses of standard Type W hoists.

Whitman & Barnes Mfg. Co., Akron, Ohio. Catalogue 90, 158 pages, 4½ by 7½ inches, containing tables of dimensions and prices for twist drills, reamers, drop-forgings, drop-forged and screw wrenches, spring cutters, and flat spring and riveted keys.

General Electric Co., Schenectady, N. Y. Bulletin 42014 entitled "Headlights and Turbo-generators for Steam Locomotives," describing a turbo-generator set, designed to meet the rigid requirements of locomotive headlight service, and giving diagrams showing the assembly.

Detroit Twist Drill Co., Detroit, Mich. Catalogue 18, 251 pages, 5 by 7½ inches, containing tables of dimensions and prices for twist drills, reamers, counterbores, milling cutters, end-mills, etc. Special sections are given for millimeter sizes of twist drills and reamers.

Buffalo Forge Co., Buffalo, N. Y. Catalogue 256 of Buffalo exhaust fans for the removal of shavings, sawdust, smoke, fumes, etc., containing also engineering data and extracts from state laws regarding the provision of exhaust fans in manufacturing plants as required by law.

Manufacturers Equipment Co., 169-179 N. Jefferson St., Chicago, Ill. Circular illustrating "M. C. E." three-jaw air-operated chucks, which are furnished in two styles—semi-universal and full universal. The chucks are made in five sizes, ranging from 8 to 18 inches diameter, inclusive.

Manufacturers Equipment Co., 169-179 N. Jefferson St., Chicago, Ill. Catalogue of labor-saving devices, including two-jaw air chucks, hinge collet chucks, milling machine chucks, air cylinders, air valves, air vices, bath cock millers, self-opening die-heads, forming tools and collapsible taps.

Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill. Bulletin 34-Y treating of gas- and gasoline-driven air compressors. The "Simplat" flat disk air inlet and discharge valves with which these compressors are equipped enable high compressor speeds and efficiencies to be obtained.

Oakley Chemical Co., 26 Thames St., New York City. Information Sheet 860 on "Oakite" for cleaning metal parts preparatory to plating.

Photomicrographs of oil emulsified by "Oakite" and oil saponified by caustic, are reproduced to show their fundamental difference of action in cleaning metal surfaces.

Hammel Oil Burning Equipment Co., Inc., 400 Pine St., Providence, R. I. Catalogue of the Hammel oil burning apparatus, showing applications to steam and water-tube boilers of horizontal and vertical types; oil pump sets; oil burner governors; and oil firing valves. A list of users of the Hammel burners and furnaces is included.

R. D. Nuttall Co., Pittsburg, Pa. Circular of the Nuttall one-piece expansion joint for pipe lines, which is offered as a leak-proof device requiring no packing and eliminating loops and U-bends from pipe lines. The Nuttall expansion joint is of the accordion type, the corrugations being machined from a solid blank, and not molded or bent to shape.

Bilton Machine Tool Co., Bridgeport, Conn. Bulletin 203 to 221, illustrating and describing automatic gear milling machines, automatic manufacturing milling machines, drill presses built in single-spindle and gang types, automatic cam-feed drill presses, horizontal milling machines, rotary blow riveting machines, automatic worm milling machines, and universal gear-hobbing machines.

Chesnutt Mfg. Co., 1301-1303 Independence Ave., Kansas City, Mo. Booklet descriptive of the "Eleveyor," an elevating truck equipped with service swivel casters, which is so designed as to enable it to meet a wide range of work under difficult conditions. The "Eleveyor" elevates the load and then conveys it wherever desired. The book contains reproductions of letters of recommendation from various users of the "Eleveyor."

Stroh Steel-Hardening Process Co., Pittsburg, Pa. Catalogue descriptive of the Stroh Process, which is a method for casting the finest alloy steel together with ordinary soft steel in one solid piece. The resultant casting has a wear-proof alloy steel stratum on the wearing surfaces, while the body is composed of any desired steel and is in no way affected. Illustrations of gears, car wheels, and many large castings made by this process are shown.

Henry Disston & Sons, Inc., Philadelphia, Pa., has inaugurated a monthly house organ for its employees, the first issue of which was published in July. The title of the publication is "Disston Bits," which has a double significance, "bits" being another name for the teeth of inserted-tooth saws, one of the company's products. The announced purpose of the publication is the stimulation and crystallization of good-will and fellowship among the employees, and it is the editorial policy that all illustrations, cartoons, and editorial matter be the work of the employees themselves. The new publication, "Disston Bits" will not in any way conflict with the "Disston Crucible," the trade organ of the company, which has been issued for several years, as the objects and purposes of the two publications are dissimilar.

TRADE NOTES

Cooper Hewitt Electric Co., manufacturer of mercury vapor lamps, has moved its Philadelphia office from 124 S. 8th St. to the Drexel Bldg.

E. R. Senn & Co., manufacturers of "Belt-oil," a scientific oil for treating leather belts, have removed their offices to more spacious quarters at 52 Vanderbilt Ave., New York City.

J. N. Lapointe Machine Co. of Massachusetts, Hudson, Mass., has been organized for machine building, and a one-story cement factory building 80 by 300 feet is being erected. Ralph Lapointe is general manager.

Crossman Stamping Co., Ypsilanti, Mich., is a concern recently incorporated to do general stamping and die work. George J. Crossman is president and treasurer; A. E. Sanford, vice-president; and Lewis H. McLouth, secretary.

Bickett Machine & Mfg. Co., Cincinnati, Ohio, manufacturer of horizontal and vertical milling machines, has added a large office and engineering department to its plant, which occupies the entire second floor of the main building. The lower floor is now required for manufacturing alone.

Phoenix Mfg. Co., Eau Claire, Wis., has moved its Cleveland office from 1430 W. Sixth St. to 913-15 Engineers Bldg., in order to obtain larger quarters, which are required to care for the increase of business. W. L. Harrison is the eastern representative in charge.

Chesapeake Iron Works, P. O. Box 1123, Baltimore, Md., and Westport, Md., are building overhead electric traveling cranes of three-motor direct-current type, having from 5 to 25 tons capacity. The company also builds five-motor double-trolley cranes of any span, having capacity up to 50 tons.

Carlton Machine Tool Co., Cincinnati, Ohio, has moved to 2904 Spring Grove Ave., where a new factory having about three times the floor space of the old shop has been erected. The new shop is equipped with machinery and appliances that will facilitate the production of the line of radial drilling machines made by this company.

Columbia Machine Tool Co., Hamilton, Ohio, which recently acquired the business of the Ceramic Machinery Co., will manufacture machine tools, making a specialty of shaping machines. A plant, 66 by 190 feet, of brick and steel, is being erected, and will be in operation at an early date. E. S. Rich, formerly with the Hamilton Machine Tool Co., is secretary.

Joseph F. Wangler Boiler & Sheet Iron Works

Co., St. Louis, Mo., has moved its general offices from 1547 N. 9th St., to 911-912 Federal Reserve Bank Bldg., 415 Pine St. The company was established in St. Louis more than fifty years ago to manufacture steam boilers, tanks, and all kinds of boiler plate and sheet iron work. Joseph A. Wangler, who has been with the company for more than twenty-five years, is president.

La Salle Machine & Tool Co., La Salle, Ill., has taken out a life insurance policy for each of its employees in the group plan, the amounts of which are equal to the yearly wages, limited to a minimum of \$300 and a maximum of \$2000. It is straight life insurance, and the entire cost is paid by the company. Employees participate in the benefits of the plan when they have been in the employ of the company for six months.

Scott-Spencer Automatic Tool Co., Madison Road and N. & W. R. R., Cincinnati, Ohio, was lately organized to manufacture tools and equipment for automatic screw machines, specializing on this work exclusively. Thomas J. Scott, president, and L. B. Spencer, secretary and treasurer, are practical screw machine operators and are thus equipped by experience to design, make, and test equipment for automatic screw machines to suit various needs.

Davis-Bourneville Co., Jersey City, N. J., opened a welding institute August 1, for the purpose of giving competent instruction in the oxy-acetylene art. The institute will be in charge of Henry Cave, technical director. The class will be held at the Jersey City factory of the company, and a charge will be made to cover the cost of oxygen, acetylene, metals and other supplies consumed. Employers using the oxy-acetylene apparatus can arrange to give a limited number of employees this course in welding and cutting.

Electrical Industrial Co., Drammen, Norway, has consolidated with two other concerns in Norway—the Holm-Hansen Electrical Co., Sandefjord, and the Fridtjov Andersens Telepointage, Christiania. The association will continue to manufacture all articles in the electrical line, and will hereafter conduct its business under the name of the National Industrial Co., with main office at Sandefjord, and branch offices at Drammen and Christiania. The association is represented in New York City by Hans Karlstrud, manager of the Drammen branch, 309 Broadway.

J. T. Slocumb Co., Providence, R. I., manufacturer of machinists' tools, is building an addition of two stories to the main building 60 by 100 feet, making the building four stories in height. Another addition in the rear of the main building was erected last winter and has been in use for the past three months. The main office, stock-room and shipping rooms, will be located on the fourth floor and automatic elevator service will be provided. The additions made in the past year and a half provide facilities that more than double the production.

General Electric Co., Schenectady, N. Y., has erected a building at the Schenectady plant affording approximately 20,000 square feet floor space, which will be devoted exclusively to the manufacture of industrial heating devices. Continuous operation and the most productive grouping of machines have been obtained by the use of individual motor drive, direct-current motors being employed which range up to twenty-five horsepower. Many of the machines were developed especially to meet the unique requirements for machining, assembling and testing heating devices.

Acme Die-Casting Corporation, 5 Bush Terminal Bldg., Brooklyn, N. Y., has issued a statement to the effect that the suit recently brought against it by the Doehler Die-Casting Co. for infringement of patent No. 1,156,093 is limited strictly to the use of certain alloys of aluminum die-cast by a certain process. It does not cover aluminum zinc, aluminum manganese, or aluminum alloys containing 8 per cent or less of copper or more than 20 per cent of copper. The suit does not in any way affect the product and present business of the corporation, as it covers a process not now in use.

Cincinnati Grinder Co., Cincinnati, Ohio, manufacturer of plain, cylindrical, universal, and internal grinding machines, is building a modern plant on Colerain Ave., in the heart of the West End manufacturing district. The new plant will afford 35,000 square feet of floor space and will be modern in its equipment and appointments. The building is of brick and steel construction with saw-tooth roof, and will have a two-story front. The offices will be on the second floor, which is 40 by 96 feet. The rapid growth of the concern has made larger and better facilities for manufacturing imperative. Provision has been made for further extending the plant as the need for more room is felt.

Willard Machine & Tool Co., Cincinnati, Ohio, manufacturer of the Willard 13-inch tool-room lathe, has been sold to G. Mattman and Thomas L. Bratten. The firm name has been changed to Willard Machine Tool Co. Mr. Mattman is well known in the machine tool trade, having been for several years the European representative of the Cincinnati Milling Machine Co. He came to the United States from France in 1904 and worked in the shop for four years, learning the American way of building machinery. He has had wide experience both in the production and selling end. Mr. Bratten, although never identified with the machine tool industry, is also well known to the trade in and about Cincinnati, having held an executive position with the Employers' Liability Corporation, Ltd. For the present, the company will continue to manufacture the Willard 13-inch lathe, which will be somewhat improved, but the intention is to add other machine tools to the line in the near future.



CONTENTS

August 1917

Volume 23 Number 12

©Underwood & Underwood

The Caterpillar Tractor.....	1041
Industrial Exposition and Export Conference.....	1046
Pyrometers of the Past, Present and Future—A Review of Devices for Measuring the Temperature of Furnaces, their Limitations and Possible Future Developments.....	1047
Machine-cut Elliptical Gears—Laying Out and Machining Ellip- tic and Oval Gears. By Reginald Trauttschold.....	1049
Modern Toolmaking Methods.....	1056
Miscellaneous Standardized Parts for Jigs. By R. F. Pohle.....	1056
U-stakes for Piling Bar Stock.....	1057
Farm Tractors Now and After the War—Editorial.....	1058
Replacing Old Machine Tools with New—Editorial.....	1058
Importance of Study of Shop Mathematics—Editorial.....	1058
The Law of Warranties. By Chesla C. Sherlock.....	1059
Relation of Rate of Cooling to Physical Properties of Forgings.....	1059
Snapshots on the Road—The Right Side of a Piece of Steel— Assembling a Clock Movement in Two Minutes—Broaching Cast Iron—Duplicate Form Turning—What's the Matter with the Munitions Makers?—How a Double-angle Milling Job was Handled—Lapping Gages for Profit—Using up High-speed Steel Drills. By the Field Editors.....	1060
Gridley Turret Lathe Equipment—Chucks, Forming and Cut- ting-off Tools, Drill-holders, Knurling Tool-holders, Turn- ers, Back-rests, etc. By Douglas T. Hamilton.....	1063
Special-purpose Turret Lathe with Ball-bearing Spindle. By T. S. Macewan.....	1067
Grinding Wheel Grades.....	1068
The Tumbling Barrel. By G. R. Smith.....	1068
Use of Formed Solder.....	1069
Industrial Oxygen Explosions—Causes of Rupture of Storage Cylinders used in Welding and Cutting Operations. By Edward K. Hammond.....	1070
Taper Machine Reamers.....	1072
Pumps for Operating Hydraulic Presses—Formulas for Deter- mining Sizes of One-, Two- and Three-plunger Pumps. By A. Lewis Jenkins.....	1073
Ignorance in Starting a Manufacturing Business.....	1075
Engineering Council.....	1075
Factory Transportation—2. By Edward K. Hammond.....	1076
After the War—What of Machinery Export?.....	1088
Gages for Time-fuse Parts—Problems in the Manufacture of Gages for Russian Time Fuses and Methods by which they were solved. By Donald A. Baker.....	1089
Determination of Blank Diameter for Drawn Metal Shell. By H. S. Brady.....	1097
Making Square Stock Octagonal. By Guy H. Gardner.....	1097
Blanking and Folding Punches and Dies. By Ernest A. Walters.....	1098
Knife Grinding Fixture. By S. W. Potts.....	1099
Coating Castings with Chalk. By Donald A. Hampson.....	1099
Chart for Powers Transmitted by Leather Belts. By N. G. Near.....	1099
Automatic Stop for Blanking Dies. By Joseph Ahlers, Jr.....	1100
Improved Form of Oil-cup. By John J. McGauley.....	1100
Reducing Glare of Electric Bulb. By Fred Fruhner.....	1100

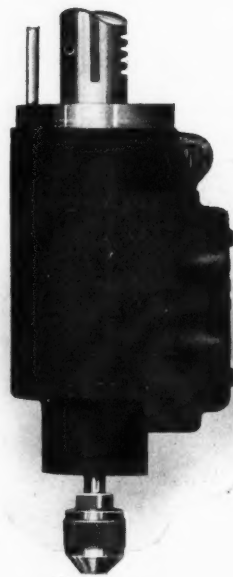
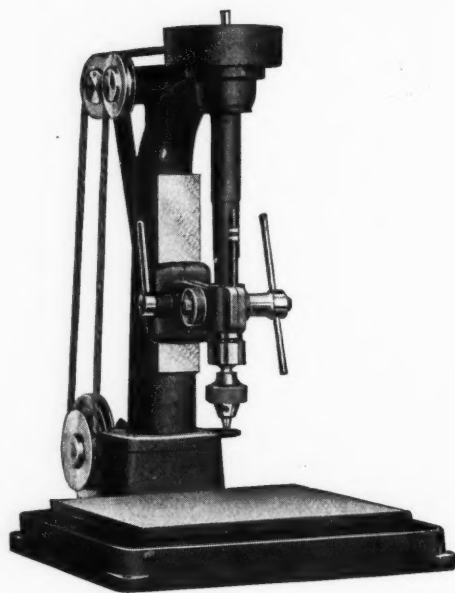
Centering Sleeve for Platen-rod.....	1100
Countersink Sleeve. By August J. Lejeune.....	1101
False Graphic Representation. By Robert Grimshaw.....	1101
Finding True Angle of Valley Plates for Steel Hoppers. By L. M. Hamlet.....	1101
Stub-tooth Bevel Gearing. By Edward J. Rantsch.....	1101
Die for Producing Small Steel Pieces in One Operation. By W. B. Greenleaf.....	1102
A Simple Jig. By Eric Lee.....	1102
Heavy-duty Punch. By C. G. Williams.....	1102
To Prevent Breaking Vulcanite-mounted Magnifying Glasses. By R. C. Scholz.....	1103
Safety Attachment for Ladders. By W. A. Laller.....	1103
Hardening Kink. By E. Kern.....	1103
Toolmaker's Clamp. By August J. Lejeune.....	1103
Cutting-off Tools. By P. Bertles.....	1103
Grinding Edge Tools on Emery Wheel. By M. E. Duggan.....	1103
Setting an Angular Cutter for Milling Spirals. By Stanley Edwards.....	1104
Lighting Staircases. By Robert Grimshaw.....	1104
Double Keyway Milling Fixture. By W. R. Stults.....	1104
Hobs and Multi-cutters.....	1105
Marking Countersink Angles on Drawings.....	1105
Why Didn't it Explode?.....	1105
Grinding Taper Plugs in Brass Valves.....	1105
Castling Lamp Bases and Coffin Handles without Cores.....	1105
Resistance of Shear Pin.....	1105
Melting Copper in an Iron Cupola.....	1105
Measuring Dovetail Slides.....	1106
Measuring Force of a Hammer Blow.....	1106
Concerning the Diameter of a Shaft.....	1106
Strength of Rope for a Cable Bridge.....	1106
Trigonometric Functions for Any Angle.....	1107
Gang and Multiple-spindle Drilling Machines.....	1107
Toggle Friction Clutch.....	1108
New Machinery and Tools:	
Leeds & Northrup Optical Pyrometer.....	1109
Cross-feed Mechanism for Ott Grinder.....	1110
Metalwood Straightening Press.....	1111
Westinghouse Oven Heater.....	1111
Davis Tool-room Lathe.....	1112
Tuthill Spring Co.'s Tracing Board.....	1113
Betts Tire Turning and Boring Mill.....	1113
Columbia 20-inch Crank Shaper.....	1113
Westinghouse Automatic Starters for Induction Motors.....	1114
Fox Arbor Press.....	1115
Skelton Taper Reamer.....	1115
Shell Forming Attachment for Cincinnati Lathes.....	1115
Armstrong-Blum Metal-cutting Band Saw.....	1115
Bilton Universal Gear-hobbing Machine.....	1116
United States Electrical Grinder.....	1117
Spot-facing Tools. By F. B. Jacobs.....	1119
The Grinding Wheel.....	1120
Lessons from British Experience.....	1124

High Speed Drilling and Tapping For Munition Manufacturers

Put your small drilling and tapping jobs onto Leland-Gifford Ball Bearing Bench Drilling Machines fitted with Leland-Gifford No. 1 Ball Bearing Tapping Attachments, and obtain maximum production with greatly reduced drill and tap breakage.

Speeds up to 10,000 R. P. M.
Maximum Diameter of Drills $3/8"$
Maximum Diameter of Tap $3/16"$
Any Number of Spindles from 1 to 6
Bench or Floor Type with Foot Feed
Good Deliveries
Bulletins 502 and 113

If your work demands a machine of larger capacity look up our Heavy Duty Drilling Machine with No. 2 tapping attachment.



LELAND-GIFFORD COMPANY WORCESTER, MASS., U. S. A.



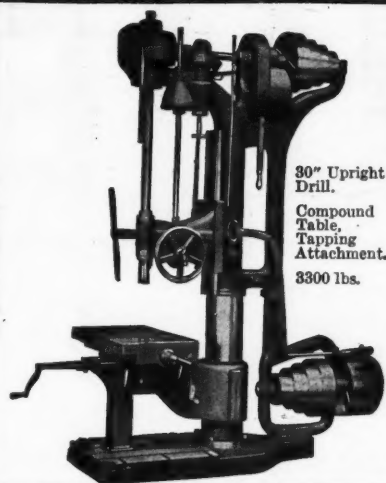
Branch Offices:

NEW YORK . . . BOSTON
CHICAGO . . . DETROIT

Domestic Agents:

Swind Machinery Co., PHILADELPHIA
The W. M. Pattison Supply Co., CLEVELAND
Somers, Fidler & Todd, PITTSBURGH





SNYDER UPRIGHT DRILLS Are Being Bought by the World's Markets

When in need of Upright Drills for doing work which requires accuracy, be sure and ask for "Snyders." For many years they have filled the demands made on them. Great range of automatic feed, rigid in operation, accurate in production. Furnished with Tapping Attachment, Compound Table and Gear Connected Motor Drive when wanted. Made in Six Sizes—23", 25", 28", 30", 36" and 46".

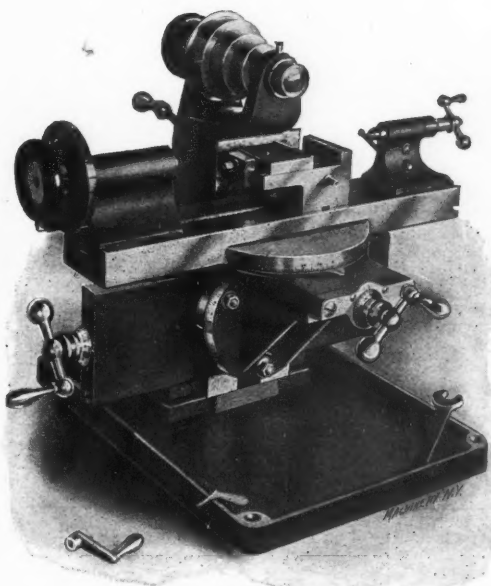
J. E. SNYDER & SON - Worcester, Mass., U. S. A.

S & C Bench Milling Machines A Few For Immediate Delivery

Every piece of work you handle on a Bench Milling Machine relieves a large miller for larger work.

The volume of work, and the variety, you can handle on a Sloan & Chace Bench Milling Machine is truly remarkable.

It is a complete machine in itself; a precision tool; made to meet the demand for a high grade machine of this type.



It has this distinct additional advantage—the cutter spindle is identical with that of our No. 5½ lathe head, and all collets, arbors, etc., can be used with both machines.

Users find this feature of great value in tool room and experimental work, since work can be transferred from one machine to the other without disturbing its setting.

SLOAN & CHACE MFG. COMPANY, Ltd.

6th Avenue and N. 13th Street, NEWARK, N. J.

Manufacturers of Precision Machinery, Bench Lathes, Drill Presses, Milling Machines, Gear and Pinion Cutters, Tools, Fixtures and Gauges

**Genuine
Walworth Stillson
Wrenches**



**Parmelee Brass Pipe
Wrenches**

**Walco Adjustable
Hex Wrenches**

New York Branch
19-21 Cliff St.

WALWORTH MFG. CO., Boston

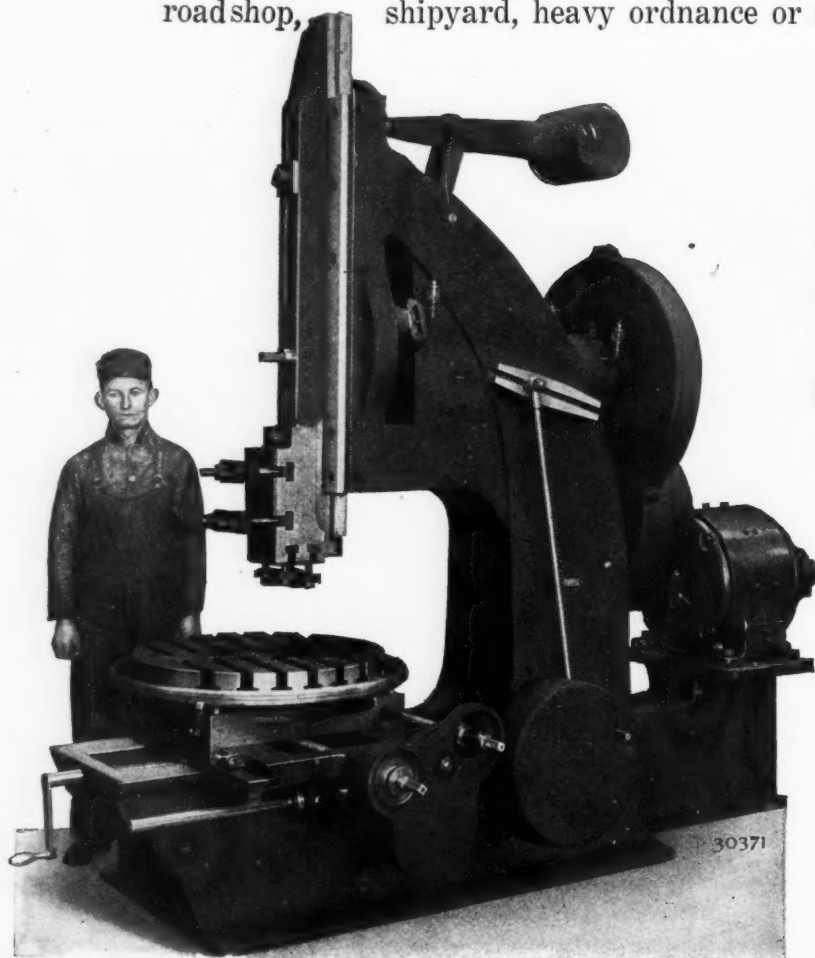
Chicago Branch
218-220 N. Desplaines St.

MACHINE

NILES-BEMENT-POND

Machine Tools, Steam Hammers, Traveling Cranes

We are by far the largest manufacturers of machine tools in the world, and are in a particularly favorable position to furnish complete machine tool equipment for a general machine shop, railroad shop, shipyard, heavy ordnance or small arms arsenal.



BEMENT
SLOTTERS
6" to 92" STROKE

*Correspondence
Invited*

NILES-BEMENT-

GENERAL OFFICES:

OFFICES AND AGENCIES

BOSTON: 93-95 Oliver St. PHILADELPHIA: 405 North Twenty-first St. PITTSBURGH: Frick Building. CLEVELAND, O.: The Niles Tool Works Co., 730 Superior Ave. HAMILTON, O.: The Niles Tool Works Co. CINCINNATI: The Niles Tool Works Co., 338 W. Fourth St. DETROIT: Kerr Bldg. CHICAGO: 571 W. Washington Blvd. ST. LOUIS: 516 N. Third St. BIRMINGHAM, ALA.: 2015 First Ave. SAN FRANCISCO: 16 to 18 Fremont St. LONDON, ENG.: 25 Victoria St., S. W. FOR COLORADO, UTAH, WYOMING AND NEW MEXICO: Hendrie & Bolthoff Manufacturing & Supply Co., Denver. FOR CANADA: The John Bertram & Sons Co., Ltd., Dundas, Montreal, Toronto, Winnipeg and Vancouver.

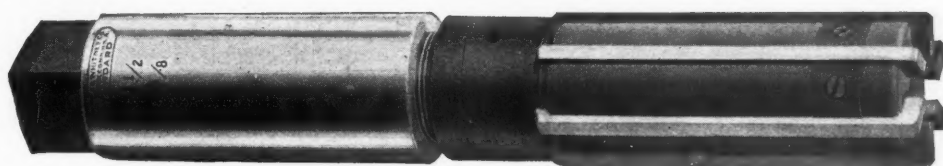
TOOLS

PRATT & WHITNEY

Precision Machine Tools, Small Tools, Standards and Gauges

The most modern manufacturing facilities backed by broad experience enable us to meet all present-day machine tool requirements, and obtain unequaled stability, power, refinement and accuracy for our various products.

P. & W. ADJUSTABLE BLADE REAMERS



These reamers have eccentric relief and can be set to size without regrinding. They are unexcelled for design, and simplicity and ease of adjustment. The eccentrically relieved blades are stronger than others, do not chatter, and produce a smoother hole. The hand, shell and fluted chucking reamers have interchangeable nuts, screws and wrenches. The bottom of a hole can readily be faced. By a simple adjustment of the blades the reamer can easily be set to size without regrinding.

PROMPT SERVICE

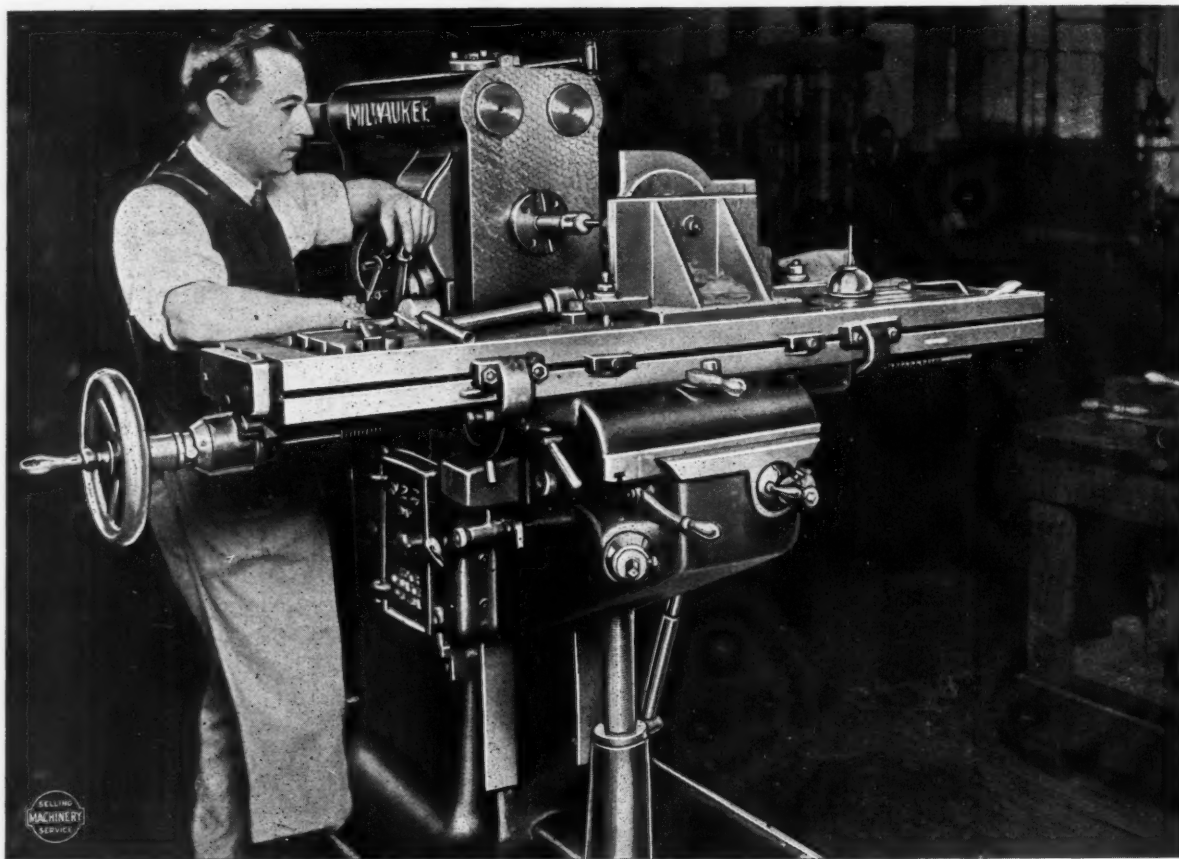
is assured at our nearest store where P. & W. Small Tools are carried in stock for immediate delivery. Place your orders there today.

POND COMPANY

111 BROADWAY, NEW YORK

OFFICES AND AGENCIES CARRYING PRATT & WHITNEY SMALL TOOLS IN STOCK
WORKS: HARTFORD, CONN.

NEW YORK: 326 Hudson St. BOSTON: 93-95 Oliver St. PHILADELPHIA: 405 N. 21st St. CLEVELAND: 730 Superior Ave. DETROIT: Kerr Bldg. CHICAGO: 571 W. Washington Blvd. ST. LOUIS: 516 N. 3rd St. CINCINNATI: 338 W. 4th St. BIRMINGHAM, ALA.: 2015 First Ave. SAN FRANCISCO: 16 to 18 Fremont St. NEW ORLEANS, LA.: C. T. Patterson Co., Ltd. ST. PAUL, MINN.: Robinson, Cary & Sands Co. DENVER, COLO.: Hendrie & Bolthoff Mfg. & Supply Co. CANADA: Pratt & Whitney Co. of Canada, Ltd., Dundas, Montreal, Toronto, Winnipeg and Vancouver.



Milwaukee Milling Machines for the finest of Machine and Tool Work

The illustration shows a Milwaukee Milling Machine in the modern factory of the Hartford Special Machine Co. This company has quite a number of Milwaukee Milling Machines which were installed about a year and a half ago when the new shop was built on the outskirts of Hartford.

The Hartford Special Machine Co. does special machine and tool work and the Milwaukee Milling Machines are called

upon to do the difficult work.

These machines have performed all kinds of milling work since they have been in operation. They have done work requiring extreme rigidity and have met every requirement. They have done work requiring extreme alignment and accuracy and have proven themselves equal to every demand.

Milwaukee Milling Machines embody many fea-

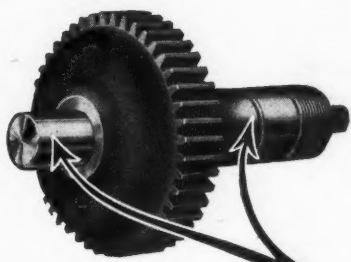
tures of design and construction. The double overarm—flanged spindle, reverse for which is self contained in the machine—solid top, box section knee—automatic flooded lubrication—cutter lubricating system an integral part of the machine—all combining for increased production, quality of output, low upkeep and ease of operation.

Catalogue No. 20 sent on request.

KEARNEY & TRECKER CO., MILWAUKEE, WIS. U.S.A.

Double Wall Support

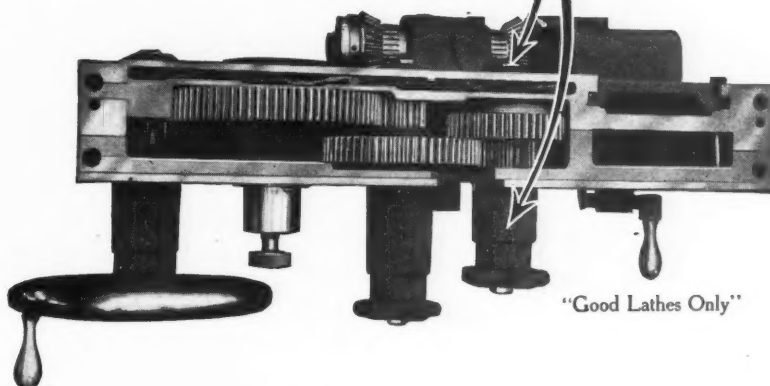
For Every Apron Stud



Large Friction Surfaces, Man Size Star Knobs to handle them with, a positive lockout to prevent throwing the half nuts and frictions in at the same time make it easy to operate.

This is just one of the many features that give the Lodge & Shipley Apron strength to furnish feeds for all the power the headstock will transmit.

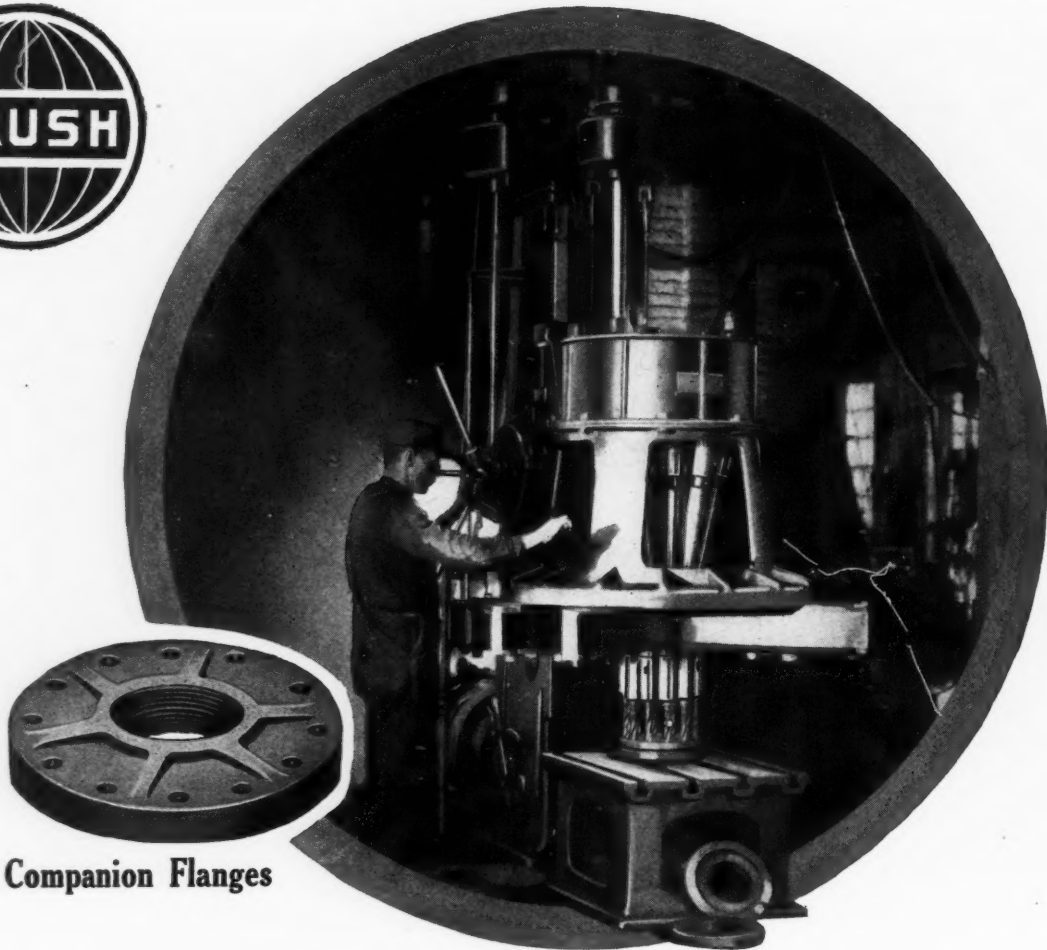
*Write for
Bulletin
M-129*



"Good Lathes Only"

Lodge & Shipley Machine Tool Co.

CINCINNATI, OHIO, U. S. A.



Companion Flanges

BAUSH DRILLS

ALL HOLES AT ONE SETTING

The machine pictured is BAUSH No. 4 Heavy Duty Multiple in operation at the Chapman-Valve Mfg. Co.'s plant, Indian Orchard, Mass.

Machine has capacity up to 20 $\frac{3}{4}$ -in., 16 1-in. or 12 $1\frac{1}{4}$ -in. high-speed drills, and it gets all there is out of those drills. As for feeds, up to .020-in. per revolution is obtainable and the No. 4 machine is guaranteed to stand it.

For drilling FLANGED PIPES, FLANGED FITTINGS, NOZZLES, SEPARATORS, EXPANSION JOINTS, UNIONS, LINED FLANGES, BONNETS, YOKES, etc., there's a BAUSH Multiple.

Have you consulted with our Engineering Department?

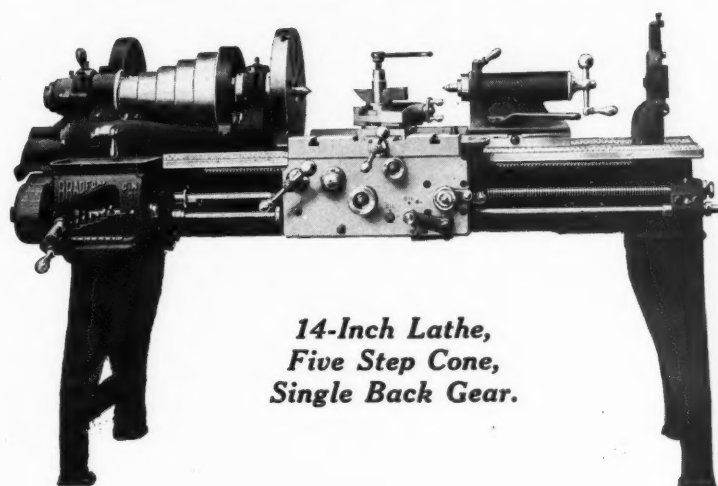
BAUSH MACHINE TOOL CO., Springfield, Mass.

Detroit Office, Dime Savings Bank Building

Manning, Maxwell & Moore, Inc., 119 West 40th Street, New York City. Fenwick Freres & Co., France, Holland, Belgium, Switzerland, Italy, Spain, Portugal. Alfred Herbert, Ltd., Coventry, England, for Great Britain, Ireland, India, Burma, Ceylon, British South Africa, Japan, Manchuria, Korea, Formosa.



**For Easy Manipulation
and Smooth Turning—
A Bradford**



*14-Inch Lathe,
Five Step Cone,
Single Back Gear.*

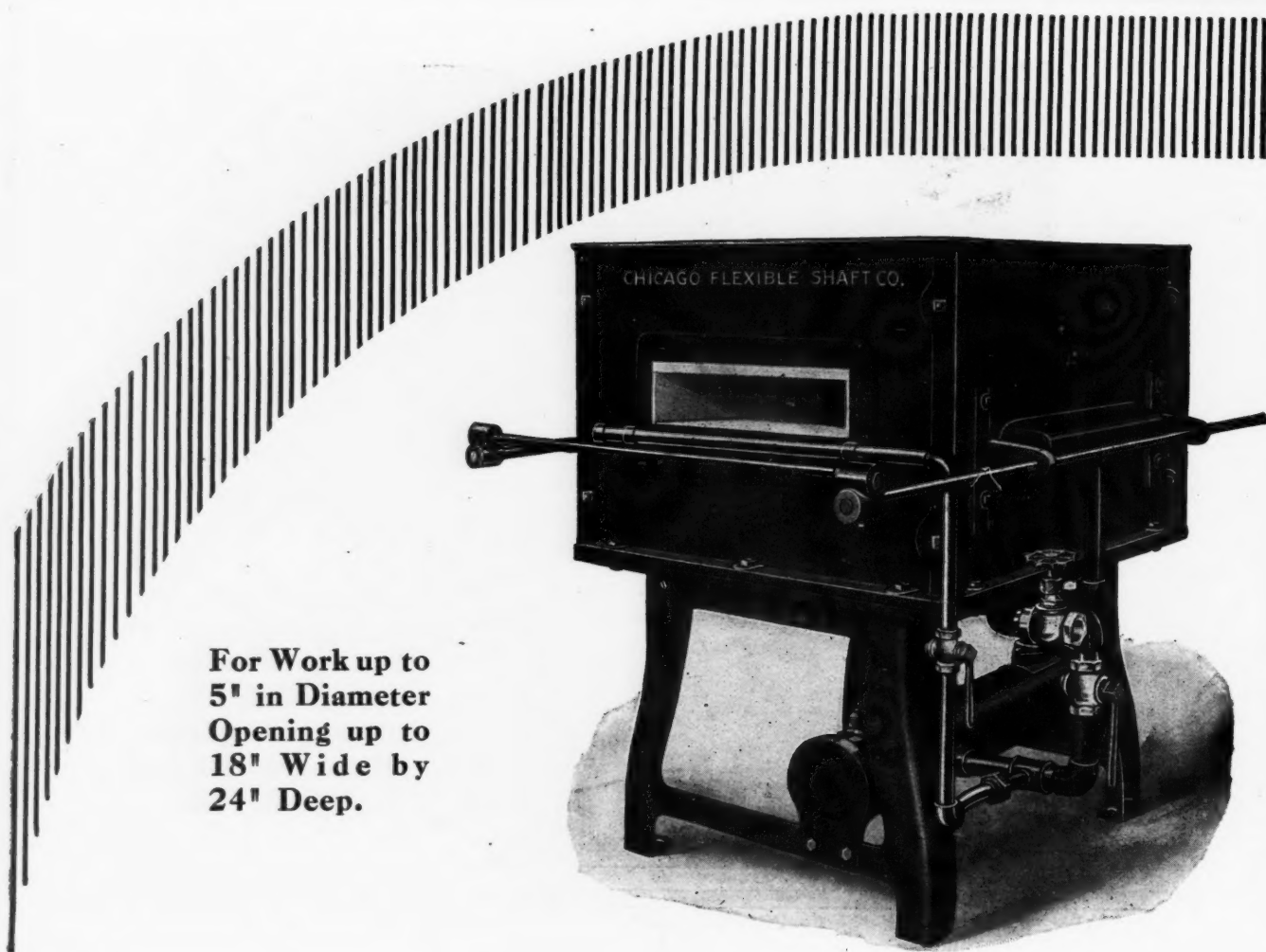
At the Hanscom Cutter Works, Hyde Park, Mass., they turn out counterbores and small cutters—good ones, too—by the bushel. In this hustling plant a 14-inch "Bradford" Lathe is among the busiest machines. With back gears out and belt running on the second (smallest) step, this machine peels the stock off small counterbores at a remarkable rate—and in spite of the high speed there's not the slightest "whip" or vibration. Stiff, compact, and well-balanced design permits the high speeds that mean fast production on such work. There are a wealth of good features in Bradford Lathes—fully outlined in our catalogue.

Send for a copy.

Bradford Machine Tool Company

CINCINNATI, OHIO, U. S. A.

AGENTS: Swind Machinery Co., Philadelphia. Taylor Machinery Co., Boston, Mass. Stocker-Rumley-Wachs Co., Chicago, Ill. Somers, Fittler & Todd Co., Pittsburgh, Pa. The E. A. Kinsey Co., Cincinnati, O., and Indianapolis, Ind. The Mine & Smelter Supply Co., Denver, Colorado. Pacific Tool & Supply Co., San Francisco, Cal.



For Work up to
5" in Diameter
Opening up to
18" Wide by
24" Deep.

Stewart Furnaces

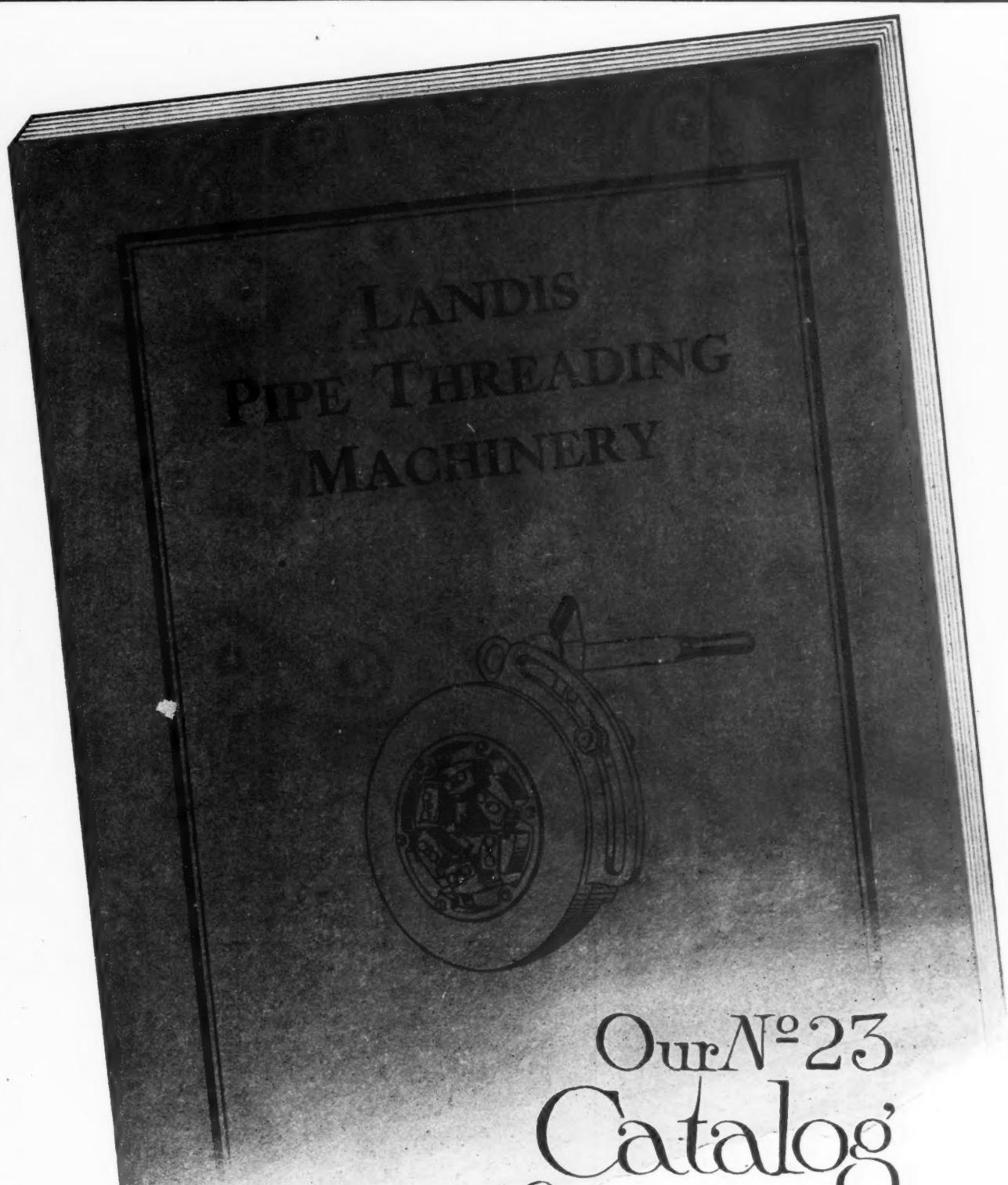
A Good Drop Hammer Forge is a Necessity

Steel has to be properly heated to make a good forging. Stewart Forging Furnaces bring work to forging heat slowly and evenly; every piece is so uniformly heated from core to edges that it flows freely under the hammer. Their use is an advantage in every other way, too, for they take up little space in comparison to their capacity, burn gas or oil, need no flue or chimney connection and are free from every objectionable feature of coal or coke fires.

Stewart Furnaces have won their place in thousands of shops by their practicality, economy both of first cost and operation and their excellent performance. Buying a Stewart is really buying guaranteed satisfaction—and at a very moderate price.

Catalogue?

CHICAGO FLEXIBLE SHAFT COMPANY
CHICAGO **149 W. La Salle Street** **ILLINOIS**

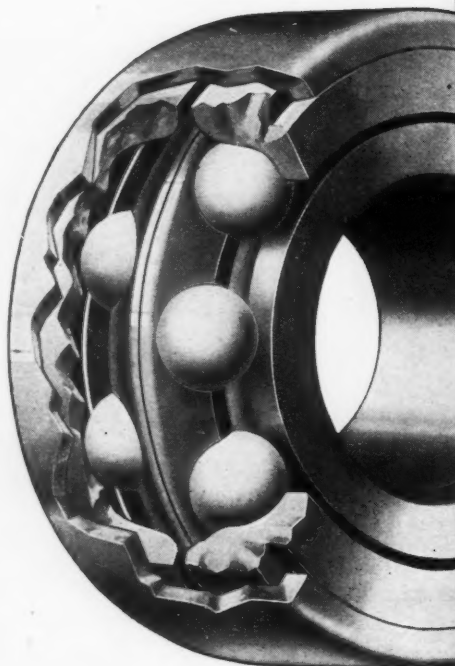
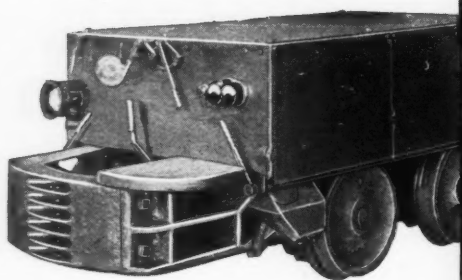
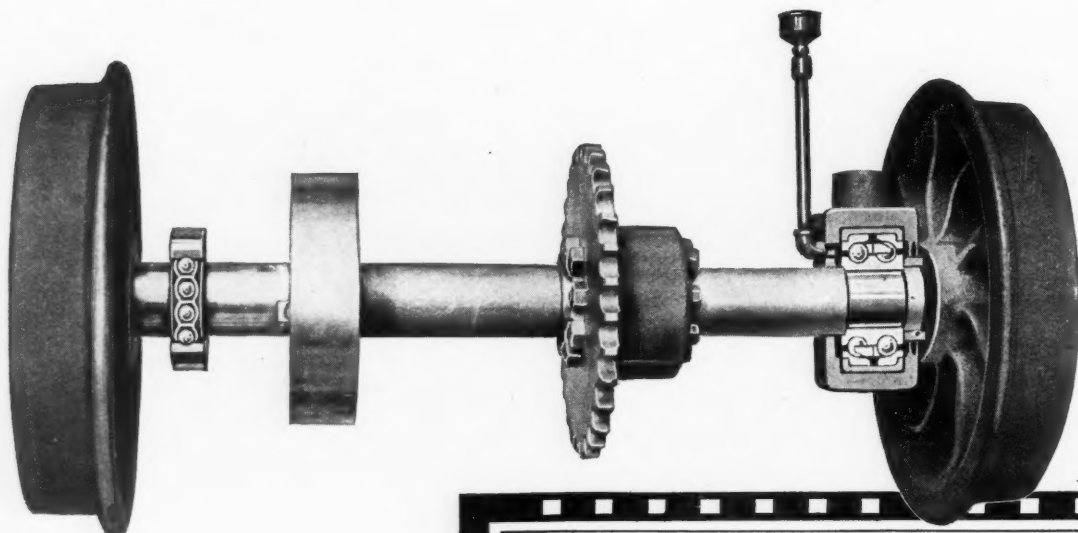


Our N^o 23
Catalog
is Now Ready for Distribution

It lists the Landis "Pipe Threading Line"—Pipe and Nipple Threading Machines, Pipe Threading and Cutting Machines, also the Landis Chaser Grinder. Well illustrated with diagrams and detailed descriptions to show the advantages of Landis Chaser and Die Head design, construction, etc.

If you have not already received a copy your name is not on our lists. You should write us at once—a post card will do.

LANDIS MACHINE COMPANY, Inc.
WAYNESBORO PENNSYLVANIA, U. S. A.



BETTER LOCOMOTIVES

Use New Departure Ball Bearings

Mr. Whitcomb, General Manager of the G. D. Whitcomb Company, says:

"We are using New Departure Ball Bearings in our mine locomotive for two principal reasons; to reduce internal friction; to secure longer life of the bearings. Ball bearings will require a minimum amount of oil and attention while the plain bronze bearings unless kept well oiled, will soon get to cutting. We have very good results with these bearings."

We need add nothing more—except to offer the suggestion that the service of your own machines might be improved in the same way by the use of New Departure Ball Bearings.

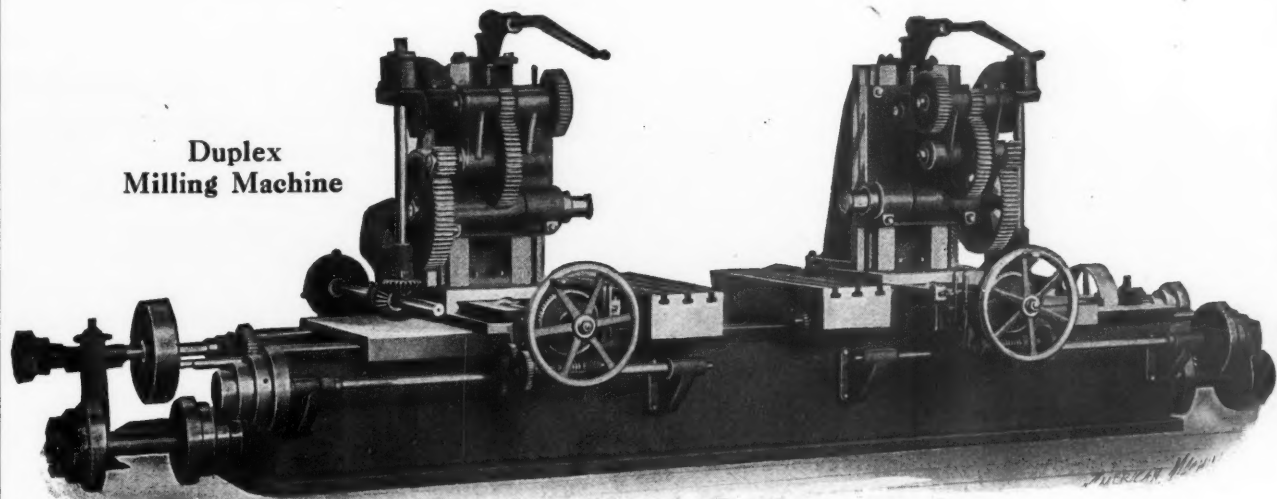
*Technical Literature and Free
Engineering Service Upon Request.*

THE NEW DEPARTURE MFG. COMPANY

Bristol, Conn. Conrad Patent Licensee Ford Bldg., Detroit

Distributors in Trade Centers throughout the United States.
Sole British Agents: Brown Bros., Ltd., London & Manchester.
Continental Europe: Jacob Holst, Copenhagen, Denmark.

NEW DEPARTURE BALL BEARINGS

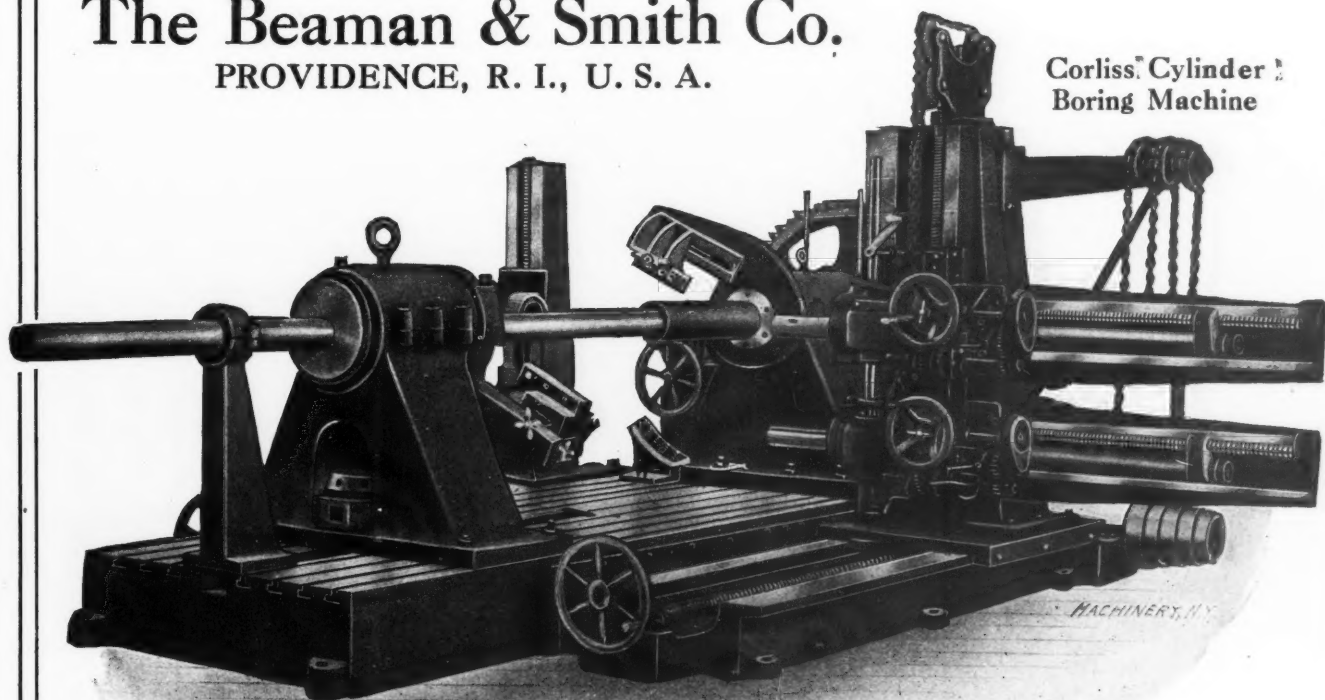


Duplex
Milling Machine

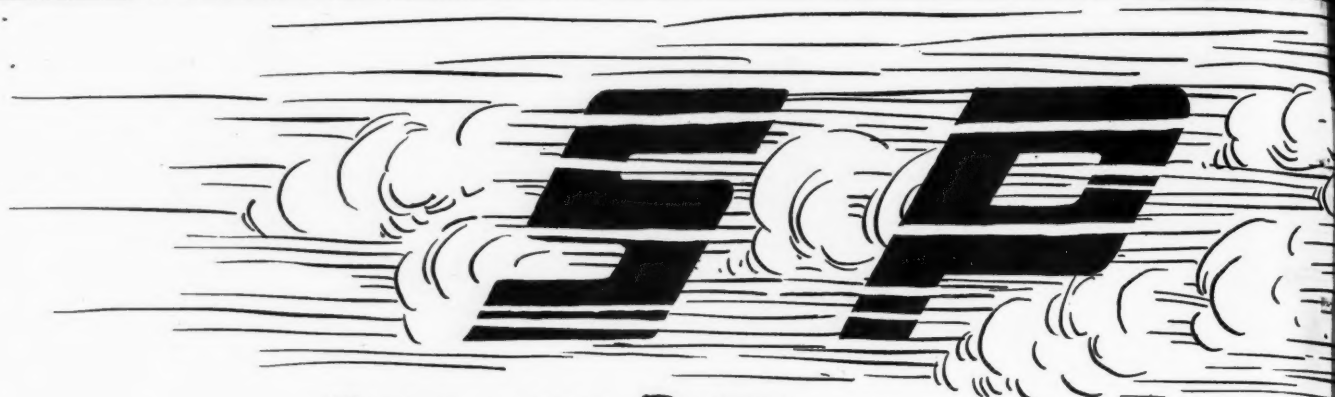
If You Want Higher Production Consult Beaman & Smith

We design and build machines for accuracy, speed, ease of operation, and to give long, efficient service—machines capable of putting through several parts at one setting or performing several operations simultaneously. Consulting us involves no obligation. If you cannot use the machines we build to advantage we will say so frankly.

The Beaman & Smith Co.
PROVIDENCE, R. I., U. S. A.



Corliss Cylinder
Boring Machine

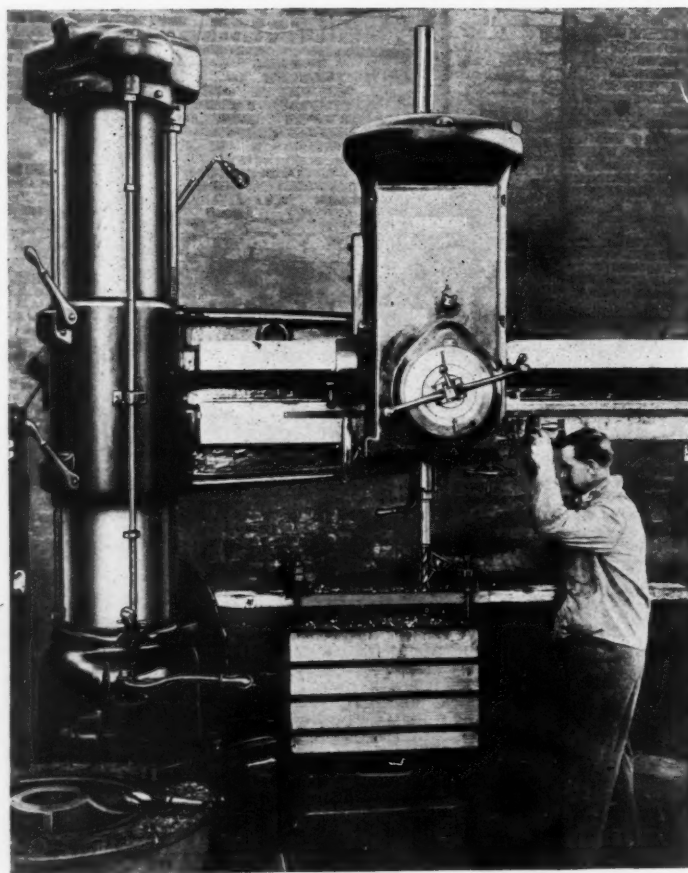


DRILLING RATE

600-1½" Holes thru 2" Steel per hour!!

1¼" Drill, 500 R.P.M., .040" Feed-35 Point Steel 2" Thick
6 seconds per hole.

THIS SURELY IS



Whitman & Barnes "Hercules" Drill used

This is nothing exceptional, however, for the new 6' "American" Triple Purpose Radial. Its excellent combination of power, spindle speeds, feeds and simplicity gives this new radial productive possibilities that simply cannot be overlooked by radial drill users.

THE AMERICAN
CINCINNATI,

LATHES

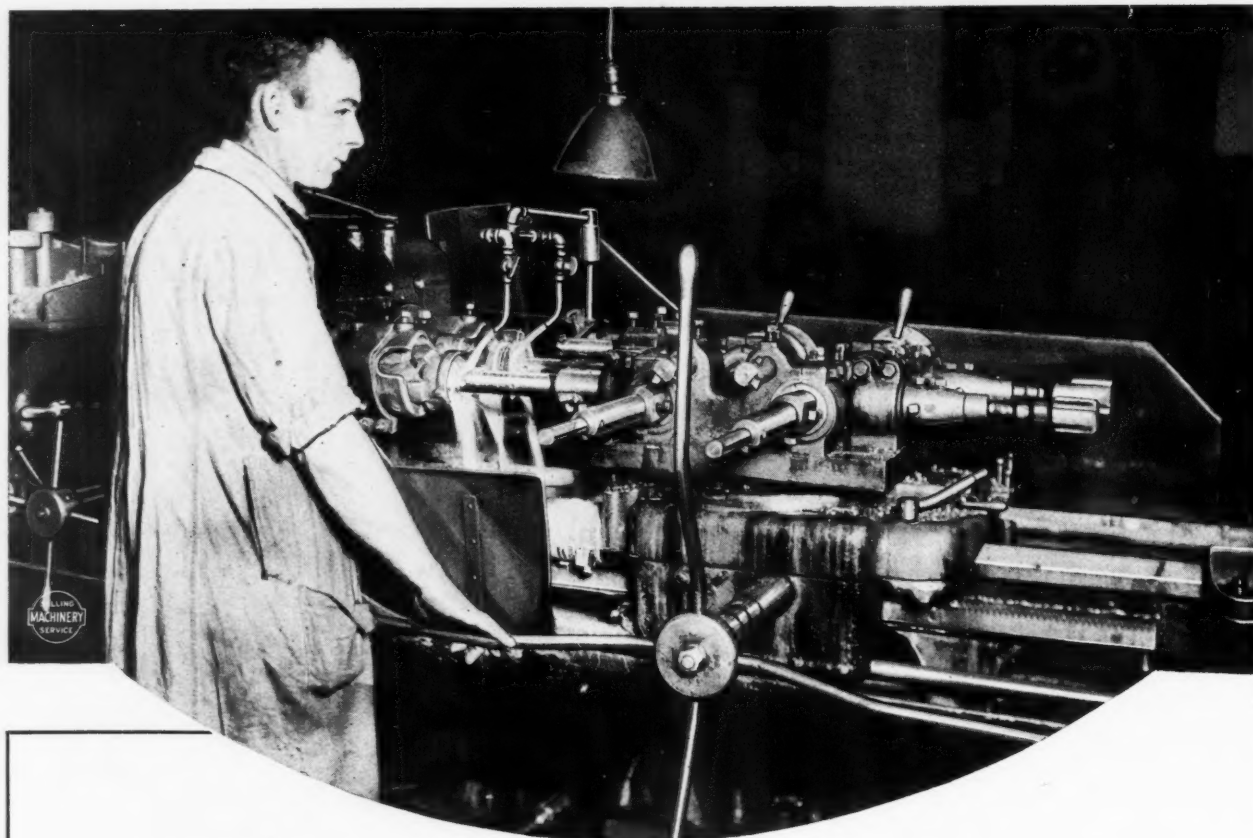
PLANERS

FEED**DRILLING RATE*****160-1 $\frac{3}{8}$ " Holes thru 4 $\frac{1}{2}$ " Steel per hour!!*****1 $\frac{3}{8}$ " Drill, 308 R.P.M., 0.40" Feed-35 Point Steel 4 $\frac{1}{2}$ " Thick
22 seconds per hole.****DRILLING EFFICIENCY**

These illustrations show two of the six "American" 6' Triple Purpose Radials in one of this country's large steel plants, where the above records were made during a test. Each of these machines is driven by an 18 H.P. motor. If you are confronted by any drilling problems, let us try to help you. If increased production is your aim, let us tell you about this new "American" drilling wonder.

TOOL WORKS CO.**U. S. A.**Whitman & Barnes "Hercules" Drill used**SHAPERS****RADIALS**

The Double Spindle



**Production
Figures Mean
Nothing Unless
the Conditions
are All Stated**

Here are the figures. Fifty-four complete pieces per nine-hour day, *average* time according to the company's records. Seventy-two completed pieces per nine-hour day is an *actual* record.

Here are the conditions. The two brake carriers are first chucked. At the first position of the turret the three diameters are rough bored and the lugs on the outside are rough turned. Second position of the turret the 2.249" diameter is finish bored and the lugs on the outside are finish turned. Third po-

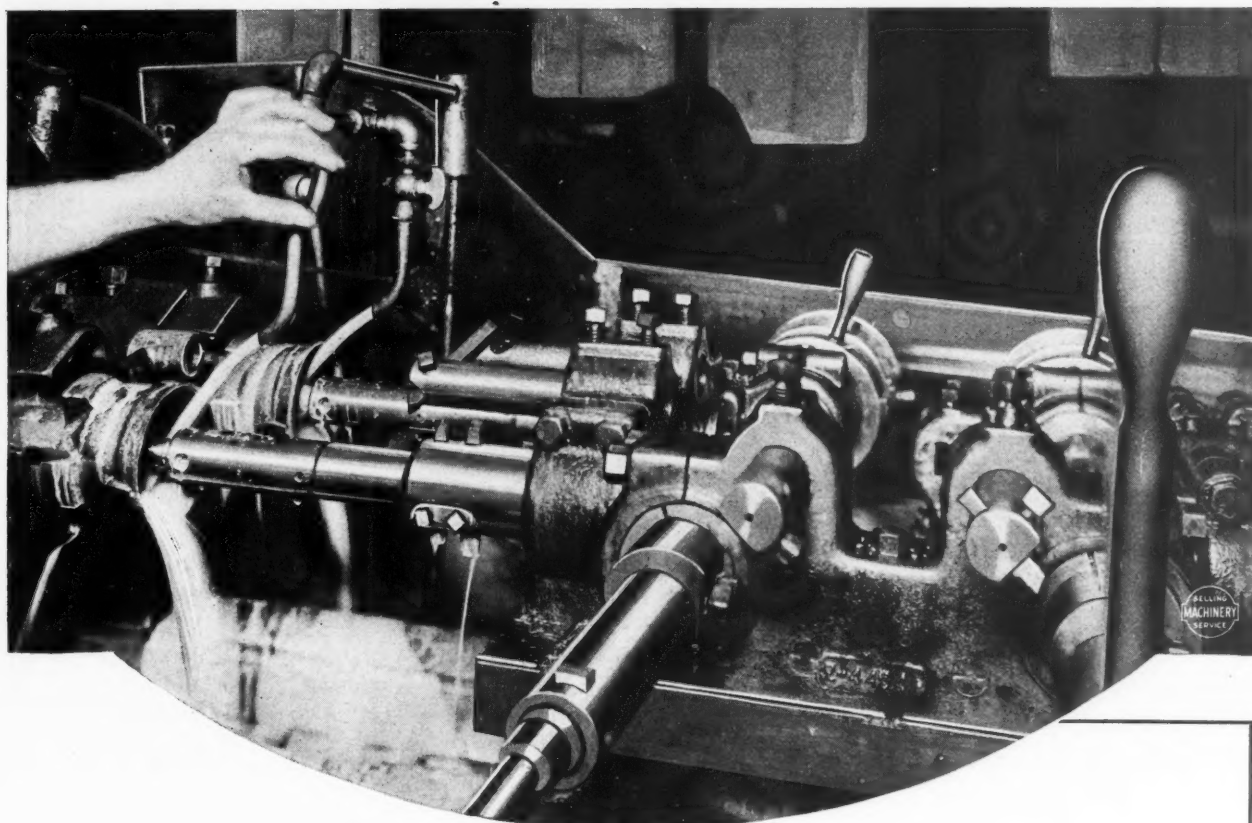
sition of the turret, finish bore 3.9375" hole, the 4 9/32" hole and ream the 2.249" hole, including facing the end and chamfering. At the fourth position of the turret, the 4 3/8" hole is tapped.

**SPRINGFIELD, VERMONT
U. S. A.**

JONES & LAMSON

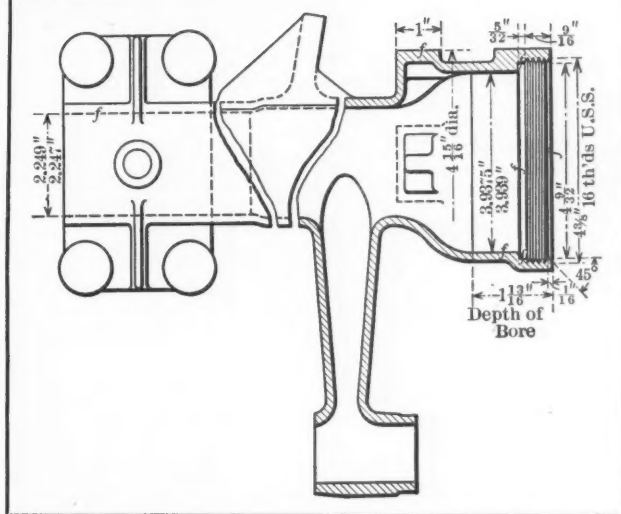
AGENTS:—FRANCE, SPAIN, BELGIUM: F. Auberty & Co., 91 Rue de Maubeuge, Paris.

Flat Turret Lathe



The time has been given and the conditions have been stated. Draw your own conclusion! If there is any other machine on which this can be done faster and better than the Jones & Lamson Double Spindle Flat Turret Lathe—we would like to hear about it.

This illustration was secured through the courtesy of the H. H. Franklin Manufacturing Co., Syracuse, N. Y., where there are fourteen double spindle flat turret lathes in use. With that number in service the Franklin people realize their full possibilities; but output in this plant is no greater than may be secured anywhere with these machines on similar work.



Why not get thoroughly posted on the possibilities of the Flat Turret Lathe? Single and Double Spindle—each for a particular purpose.

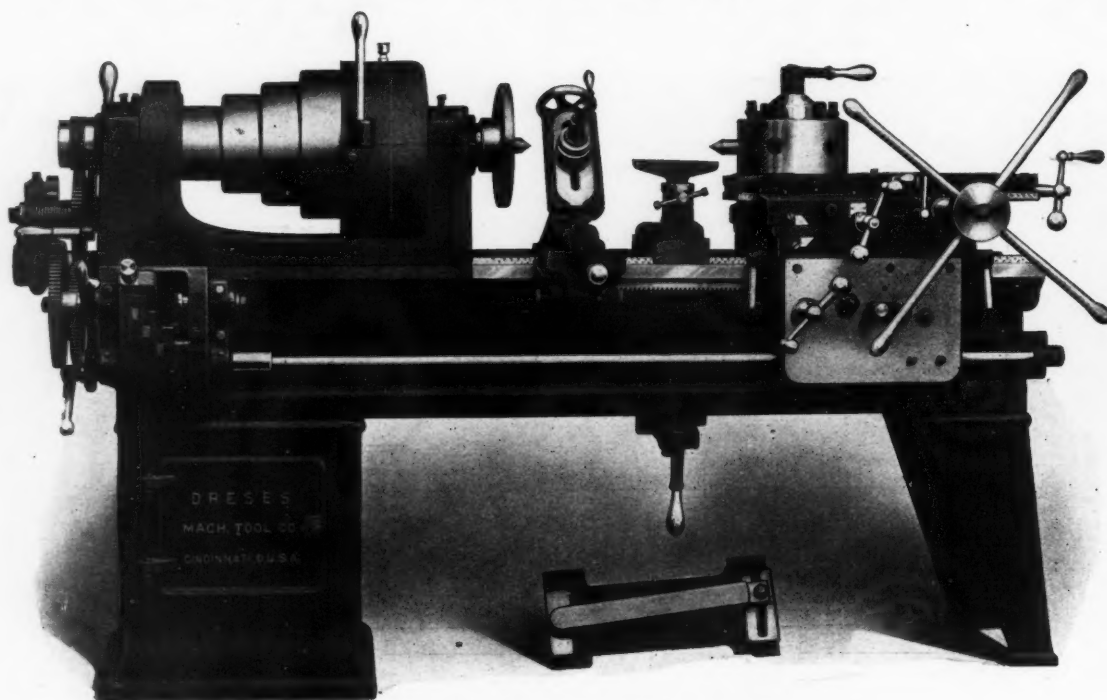
MACHINE COMPANY

**109 QUEEN VICTORIA ST.
LONDON, E. C.**

HOLLAND: Spliethoff, Beeuwkes & Co., Rotterdam.

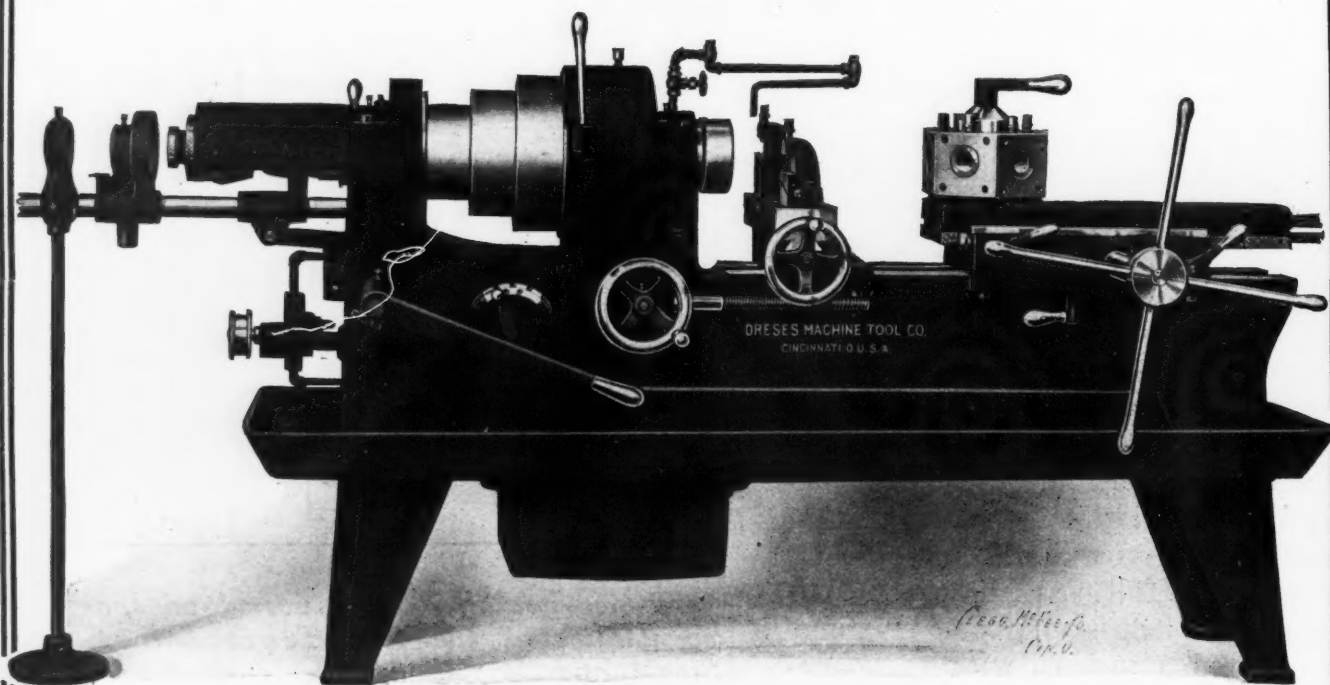
DESIGN and QUALITY

Distinguish our complete line of



14", 16", 18" and 20" UNIVERSAL MONITORS

SCREW and TURRET MACHINERY



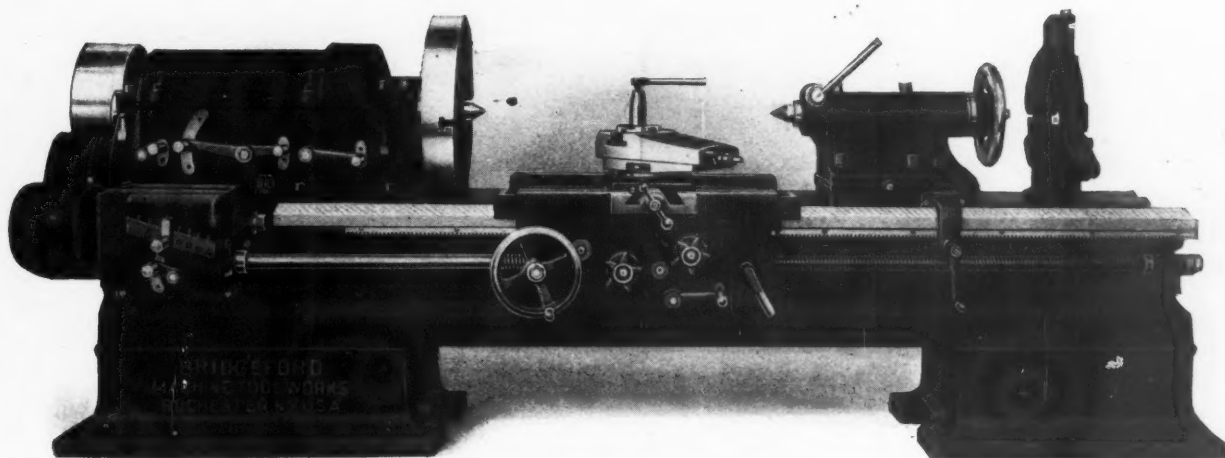
1", 1½" and 2¼" SCREW MACHINES

DRESES MACHINE TOOL CO., Cincinnati, Ohio

REPRESENTATIVES: The Fairbanks Co., New York, Boston, Philadelphia and Buffalo; Carey Machinery & Supply Co., Baltimore; E. L. Easley Machinery Co., Chicago; Badger-Packard Machinery Co., Milwaukee; William C. Johnson & Sons Machinery Co., St. Louis; The Chas. A. Strelinger Co., Detroit; Canadian Fairbanks-Morse Co., Montreal and Toronto; Selson Engineering Co., London; Stussi & Zweifel, Milan, Italy; Manning, Maxwell & Moore, Inc., Mexico City and Yokohama, Japan.

Bridgeford Lathes

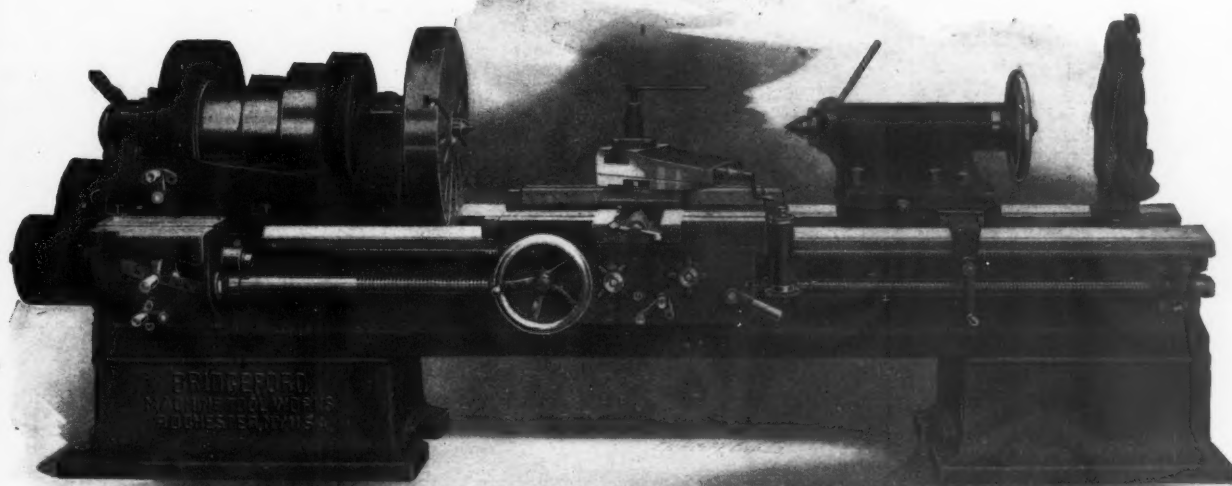
26" Cone and Geared Head Types



THERE is not a better lathe than the "Bridgeford" for handling heavy duty turning. Big shafts, heavy rolls, massive pinion blanks—work that tries the staying qualities of a lathe to the utmost—are the jobs that make up the daily work of these machines. Tremendous pulling power, backed by staunch construction and unusual convenience, make them speedy and efficient on really difficult work—the triumph of two decades of specialization in heavy lathe design.

Two models, 26" size, are shown. The Cone Drive Bridgeford is an accurate, speedy machine—a splendid all-round lathe. The Geared Head model is a wonder for heavy manufacturing, with a pulling power of 9,000 pounds.

Let us tell you more about these lathes.



SPECIALISTS IN LATHE CONSTRUCTION FOR MORE THAN 20 YEARS

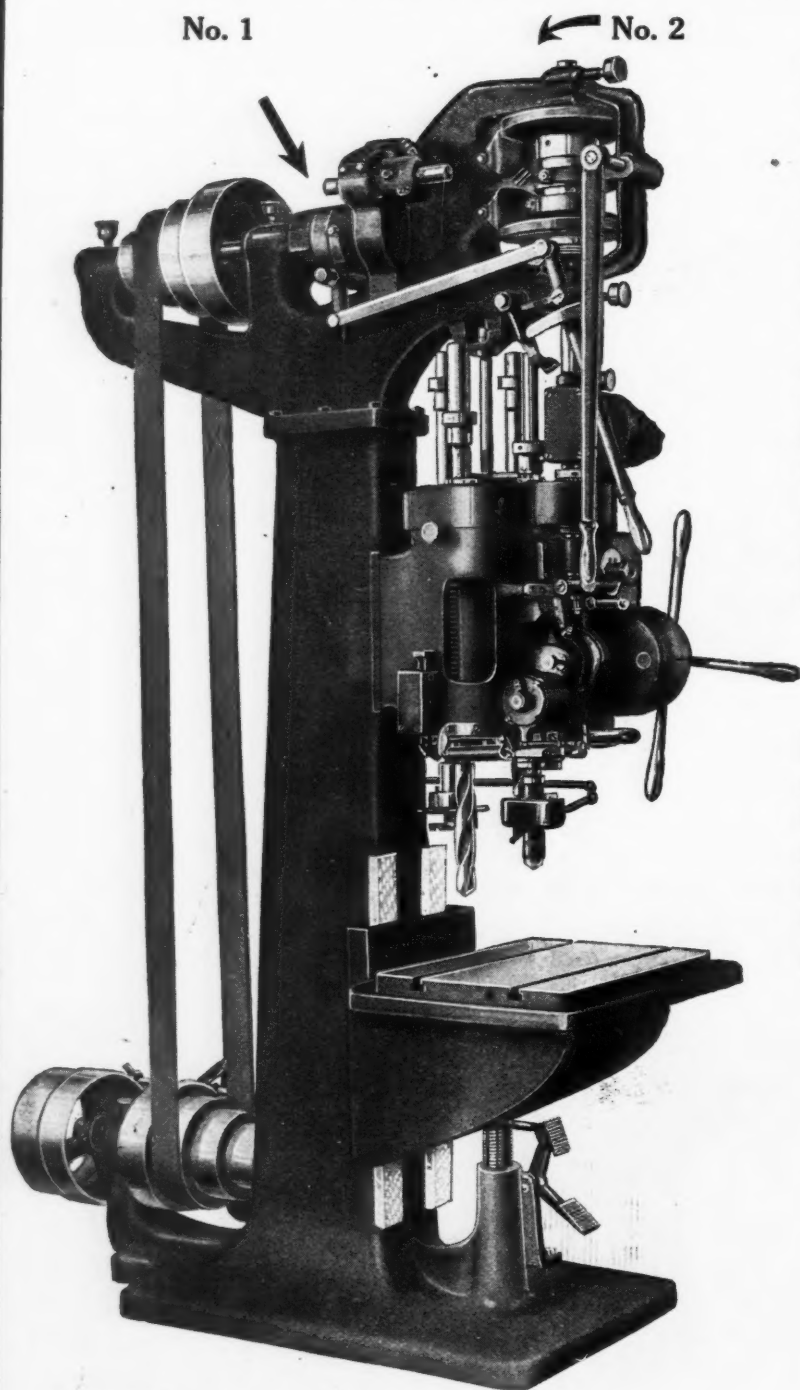
Bridgeford Machine Tool Works

151 Winton Road

ROCHESTER, N. Y.

THE JOHNSON FRICTION CLUTCH

Used on the Semi-Automatic Turret Machines Recently Put on the Market by the Turner Machine Co., Danbury, Conn.



No. 1

No. 2

The back gears on the New Turner Turret Machine, which may be thrown out of engagement like the back gears of a lathe when not in use, are operated by a No. 5 Double Johnson Friction Clutch as shown by arrow No. 1.

Another Double Johnson Friction Clutch No. 5 operates the forward and reverse of the spindles as shown by arrow No. 2.

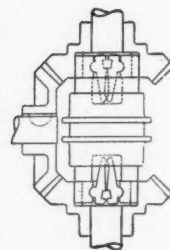
The latest and most up-to-date machines are equipped with Johnson Friction Clutches.

Why?

Because the "Johnson" is the smallest and most compact clutch and because it is more easily made to meet modern conditions and because it is the most powerful clutch of its size. It's the clutch with a reputation.



Double Clutch Exterior



Double Clutch In Nest of Gears

Courtesy of
The Turner Machine
Co., Danbury, Conn., U. S. A

**Write for Catalogue "A" and booklet
"Clutches as Applied in Machine Building."**

CANADA—Williams & Wilson, 320 St. James St., Montreal. The Canadian Fairbanks-Morse Co., Ltd., Toronto.
ENGLAND—The Efandem Co., Ltd., 159 Gt. Portland St., London, W., Sole Agents for British Isles.
AUSTRALIA—George Wills & Co., Brisbane, Queensland.

THE CARLYLE JOHNSON MACHINE CO. MANCHESTER CONN.

The Simplified Selective Speed Headstock

This is the simplest form of Selective Speed Headstock. The entire range of back geared speeds is obtainable while running and under cut.

The powerful double friction back gears are capable of transmitting loads greater than the full capacity of the wide high speed driving belt, and the change from high to low ratio can be made instantly by simply shifting the back gear lever.

The belt is shifted rapidly over the cone by a single turn of an ordinary crank shown in the grasp of the operator.

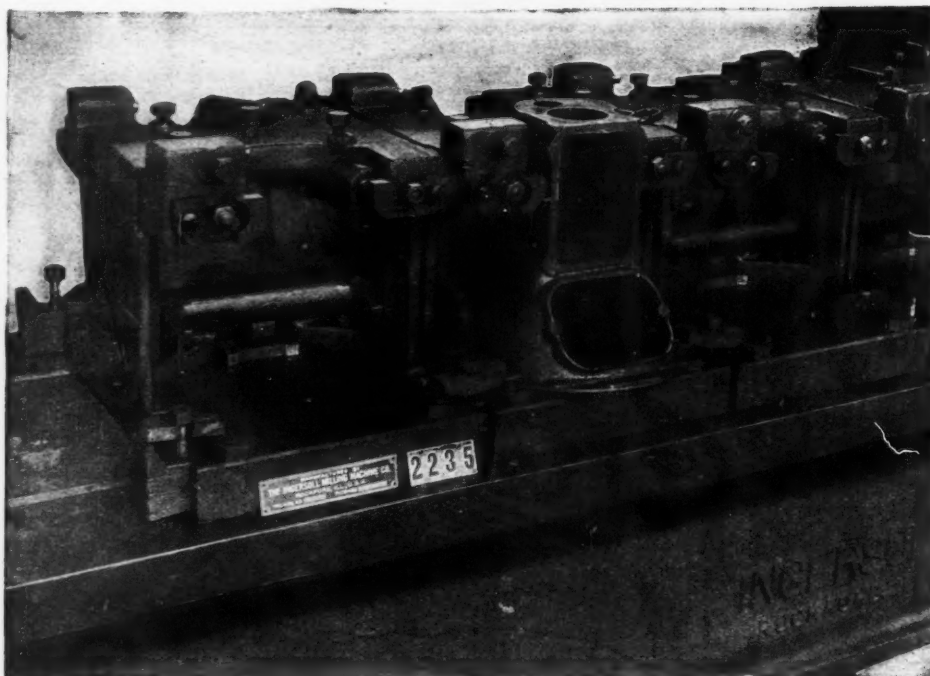
No other type of Headstock, regardless of its manufacture, provides this convenience at equal investment, and under no condition can equal its low upkeep cost and general reliability.

**The R. K.
LeBlond
Machine
Tool Co.**
**CINCINNATI
OHIO, U.S.A.**

Agents in Principal Cities



INGERSOLL



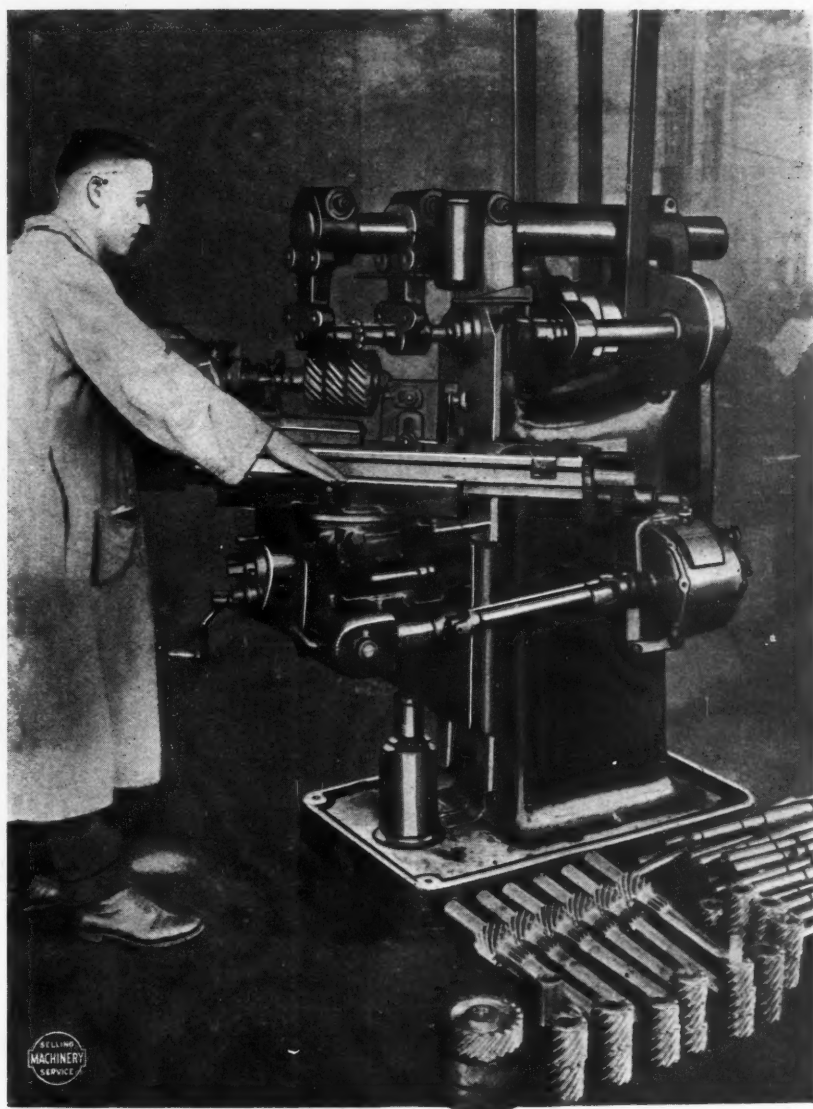
INGERSOLL HEAVY MILLING FIXTURES

are one of the most important features of Ingersoll Milling Equipment. Our experience has covered a long period of years; our designing and erecting are done by special departments devoted exclusively to fixture work. Our estimates and preliminary engineering work are absolutely without obligation to you, but our equipment is positively guaranteed.

THE INGERSOLL MILLING MACHINE COMPANY, Rockford, Ill.



FIXTURES



KEMPSMITH

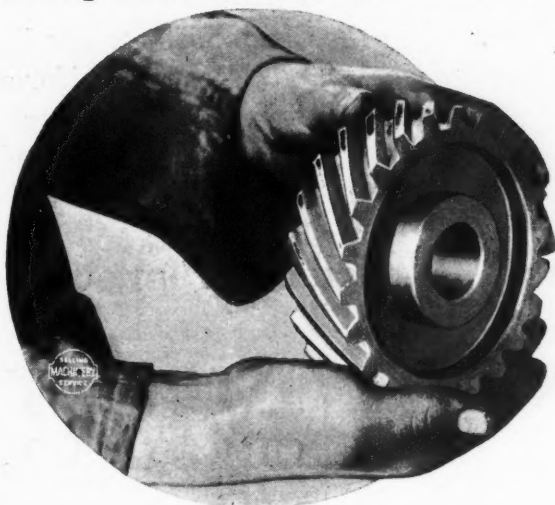
Rigidity Scores Again

45° Spiral Gears

Take a look at these gears, at the relative positions of work and cutter, the angle at which the table travels to bring three blanks under the tool at each cut. Then consider the accuracy required in gears for machine tool use. It's a job that calls for rigidity, all the rigidity that can be put into a machine.

The Kempsmith Milling Machine is built on lines which fit it for just this kind of work. It is rigid in the most absolute sense of the word, with ample power to match its great strength.

It's a simple machine to operate, a rapid producer even on exacting work. Awkward positions, or hard-to-get-at surfaces are no bar to Kempsmith efficiency. Just what Kempsmith milling can do towards boosting production and lowering costs, we want to show you—the sooner the better.

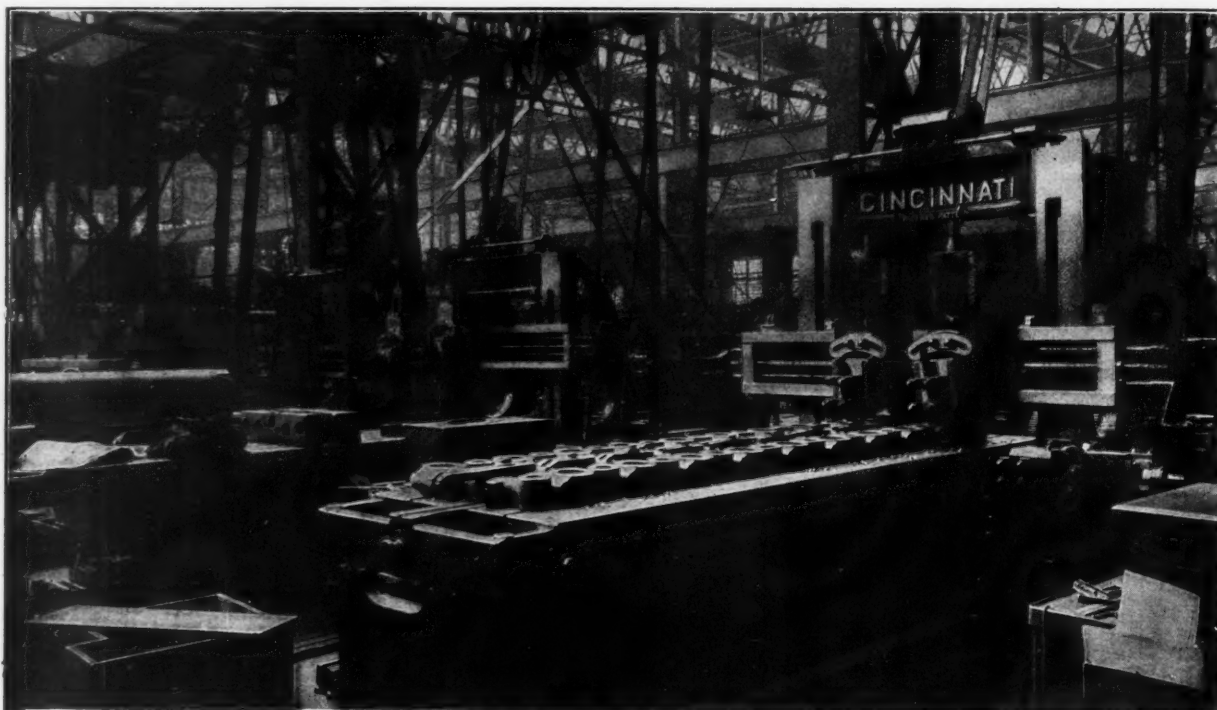


Write us.

KEMPSMITH

MILWAUKEE, U. S. A.

Cincinnati Planers



An Economical Way to Machine Gas Engine Connecting Rods

We've just received from our printer a new booklet that is sure to interest every planer user or owner.

It shows 28 typical planer jobs in as many different shops—gives some side-lights on the way the "other fellow" does it.

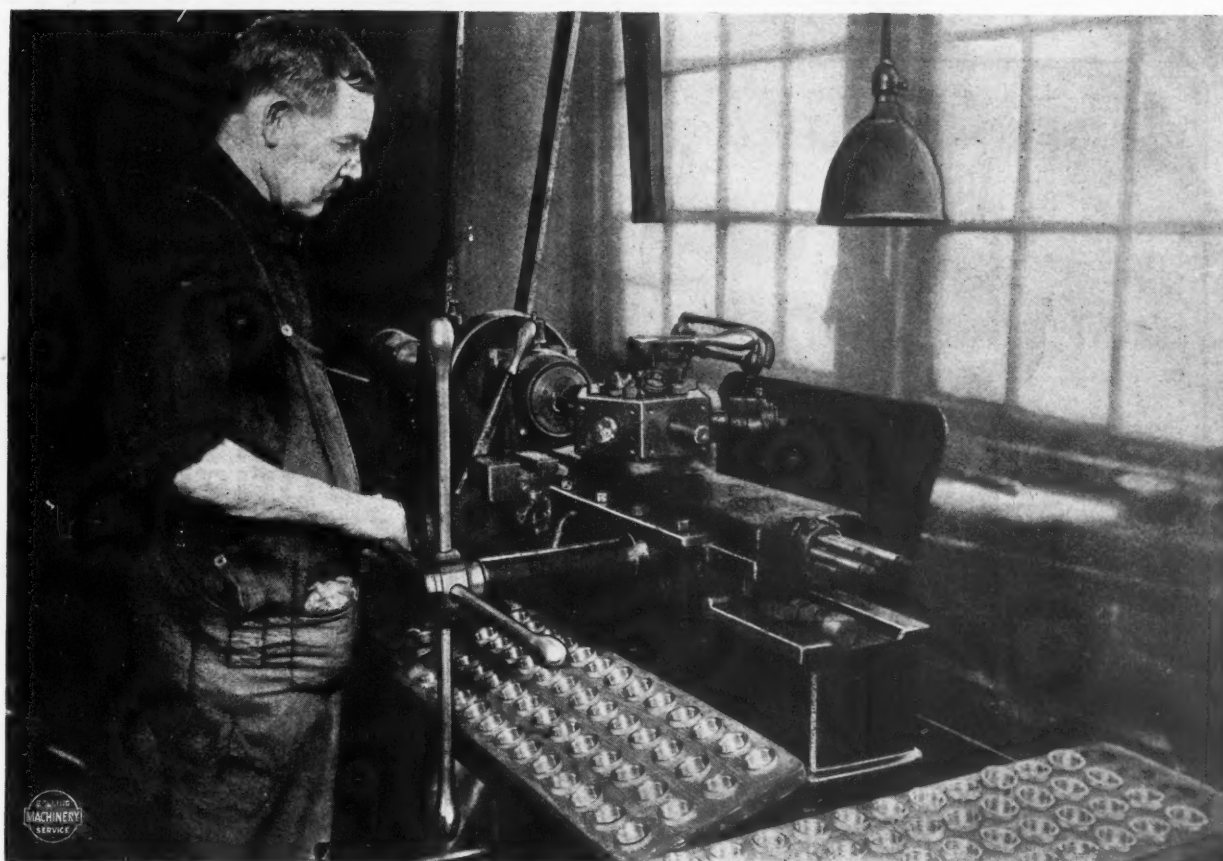
Better send for a copy.

This looks like a modern, efficiently conducted plant—and it is. Look at the way they plane those gas engine connecting rods! Cincinnati Planers, of course—and their full efficiency is utilized. On the 42" Cincinnati Planer of the widened type *twenty* connecting rods are clamped. These steel castings travel under the cutting tools at a speed of 40 feet per minute against a cut $\frac{1}{8}$ " deep and a traverse feed of $\frac{3}{32}$ " per stroke. Finish is good, output high, labor cost per piece very low—the usual "Cincinnati" combination.

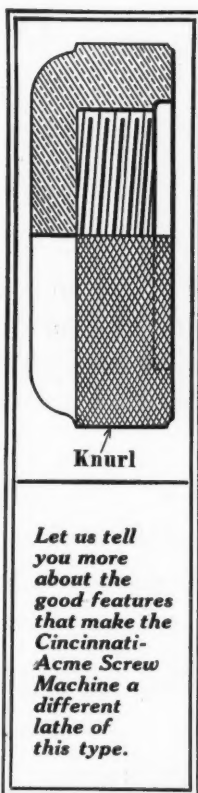
It takes a good planer—a planer like the Cincinnati—to handle work like that in quantities and maintain close and uniform accuracy. Staunch design, ample power, quick reverse, aluminum pulleys, wide, well supported vees, and easily handled operating parts are a few of the features that make

Planer Efficiency—Efficiency Planers

CINCINNATI PLANER COMPANY
CINCINNATI - - - OHIO, U. S. A.



One Minute! Nothing, or a Lifetime!



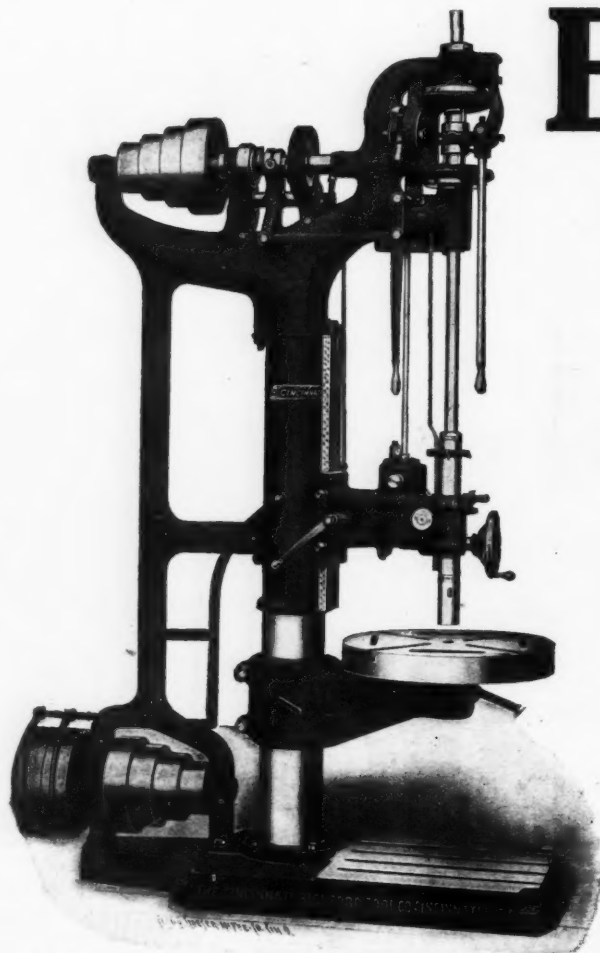
In some forms of animal life a minute is an entire lifetime; in others it is nothing. It all depends upon what is done with, or in, the minute.

One minute is sufficient time in which to complete the second operation on this brass cap—turn, face and knurl—the work being held on a thread arbor.

The machine that makes such good use of a minute is a Cincinnati-Acme Screw Machine—and this is *average* time, output is 60 per hour, all day long.

This machine has been used by the Westinghouse Air Spring Co., New Haven, Conn., for a few months only; but this has been long enough to demonstrate its efficiency and economy over a wide range of work. And there are hundreds of concerns who have demonstrated the same things.

THE ACME MACHINE TOOL COMPANY
CINCINNATI, OHIO, U. S. A.



**THE
CINCINNATI**

Built for

The Cincinnati Upright Drilling Machine

This Heavy Pattern Drill was designed for special purposes and its construction is vastly superior to the average. Study a few of its good points and you'll readily see why fine service comes so easy to the Cincinnati.

The frame is composed of a deep, well ribbed base, large accurately ground column, well shaped gear-guarded yoke, strong brace and conveniently located belt shifter. This built-in distinctiveness insures most profitable service and characterizes every part of the machine.

There are six positive, instantly available, feed changes, eight spindle speeds and a tapping attachment which acts through friction clutches and is operative at all speeds without shock or noise. This attachment possesses unusual gripping power, is adjustable, and may be disengaged when not in use. In addition to reducing tap breakage to a minimum it offers a convenient means for starting and stopping the spindle when changing tools.

Many other features contribute their share toward fine service—adjustable table, counterbalanced head, automatic trip, elevating mechanism, bronze bushed bearings, etc.

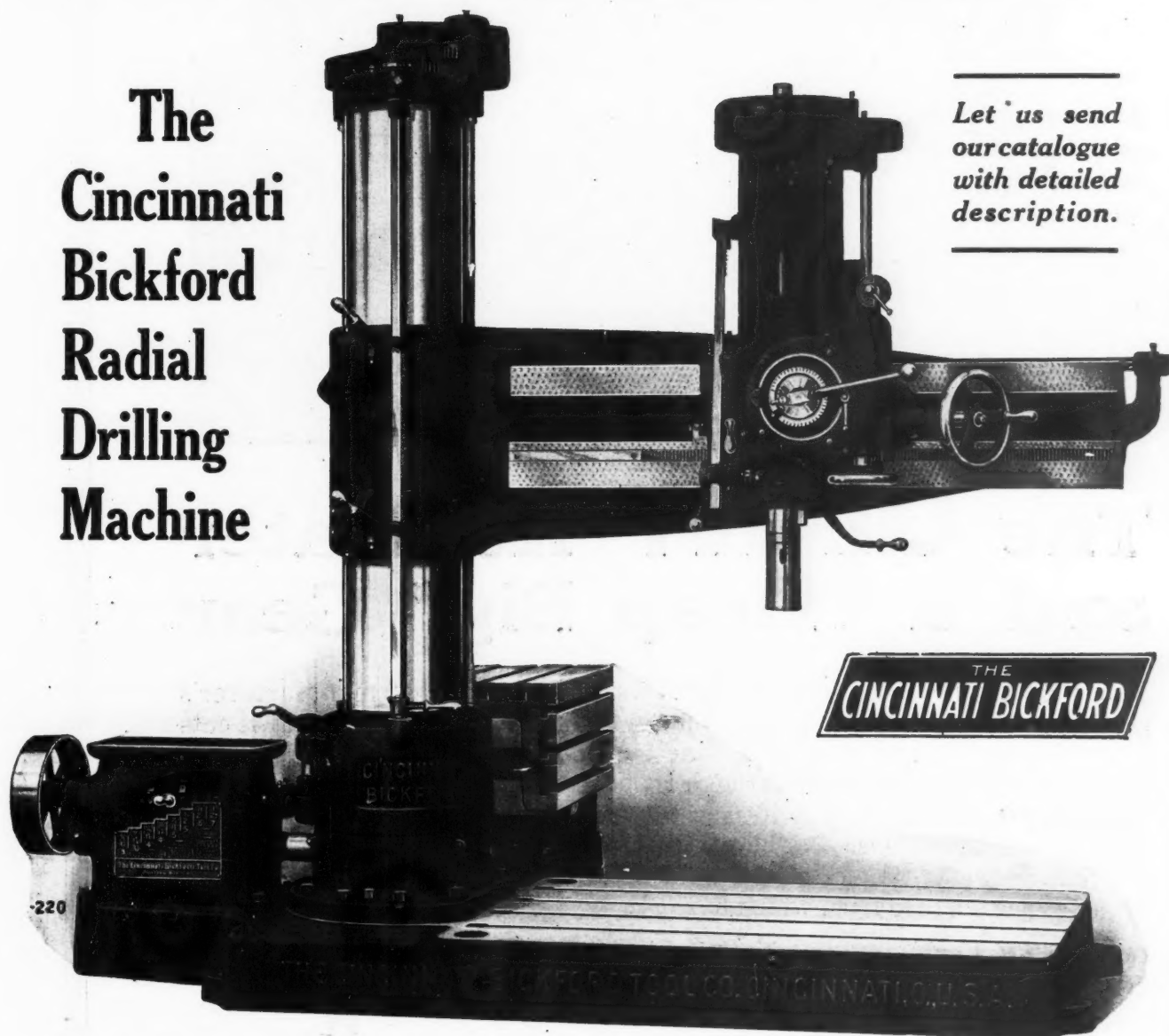
For a complete description get our circular U-4A. Copy on request.

THE CINCINNATI BICKFORD TOOL

Fine Service

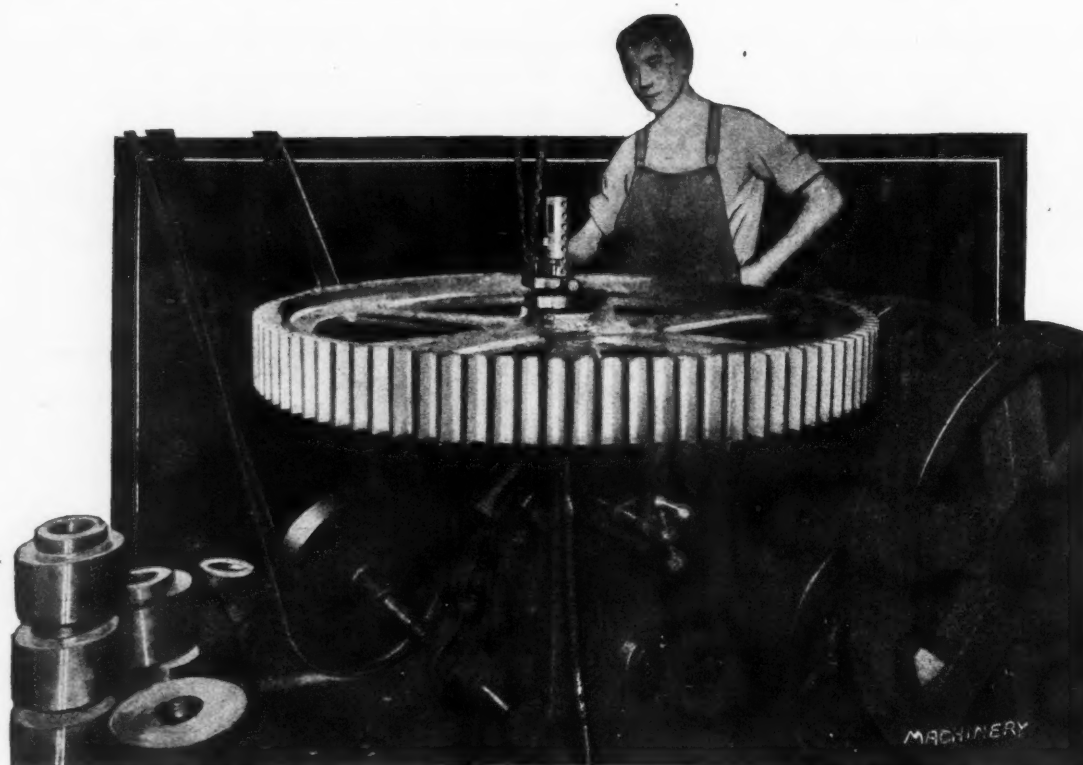
The Cincinnati Bickford Radial Drilling Machine

*Let us send
our catalogue
with detailed
description.*



The features incorporated into this drill for insuring fine, accurate work cannot be improved upon. In the arm, for instance, no other radial offers such a narrow guideway for head or has such great depth between outer edges for preventing side or end rocking. The elevating screw cannot be set in motion by accident or remain in motion after the arm has reached its limit of movement. The depth gauge insures exact drilling depth, safety stop trips feed at right instant, while the strength and rigidity of construction further aid in preserving accurate alignments and close limits.

COMPANY, Oakley, Cincinnati, Ohio



The **GIANT** Keyseater and a "Heap Big" Gear

This "**GIANT**" is an important part of a busy contract manufacturer's gear making equipment. It cuts the keyways. In this 48" spur gear it cuts a 1¼" keyseat in less than 20 minutes, including setting up and removing work. It puts smaller work through in proportionately quicker time. The "**GIANT**" Keyseater gets its speed from an exclusive feature—holding work by the bore alone. No blocks, fixtures or holding devices are required. There is no waste time or effort; no need to face hubs to get a true surface from which to work.

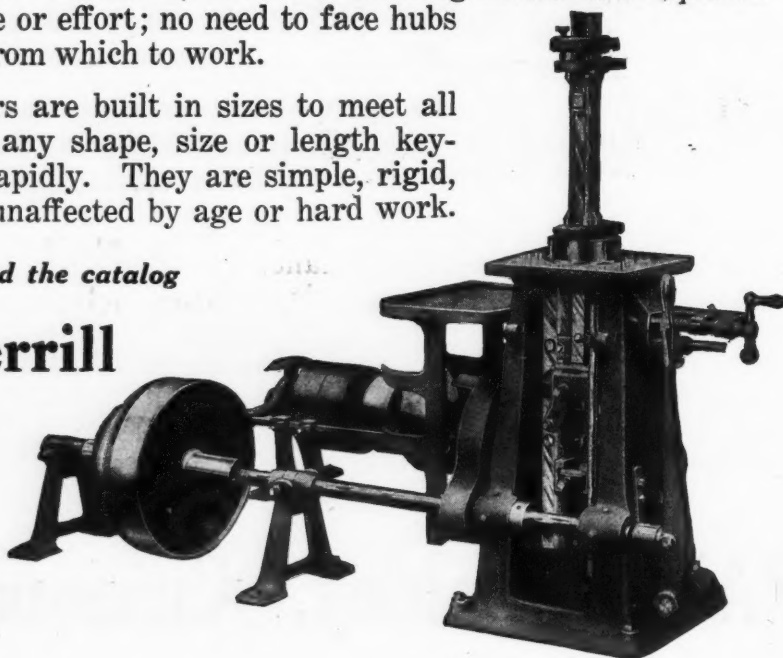
"**GIANT**" Keyseaters are built in sizes to meet all requirements—to cut any shape, size or length keyway, accurately and rapidly. They are simple, rigid, dependable machines unaffected by age or hard work.

Let us send the catalog

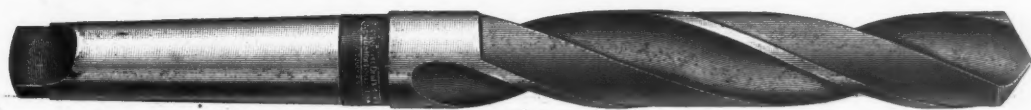
Mitts & Merrill

843 Water Street
SAGINAW
MICH.

FOREIGN AGENTS: Burton, Griffiths
& Co., Ltd., London, England. Leon
Chapuis, Paris, France. and Switzer-
land. V. Lowener, Stockholm, Sweden.
Post Van Der Burg & Co., Rotterdam,
Holland.



"MORSE" DRILLS



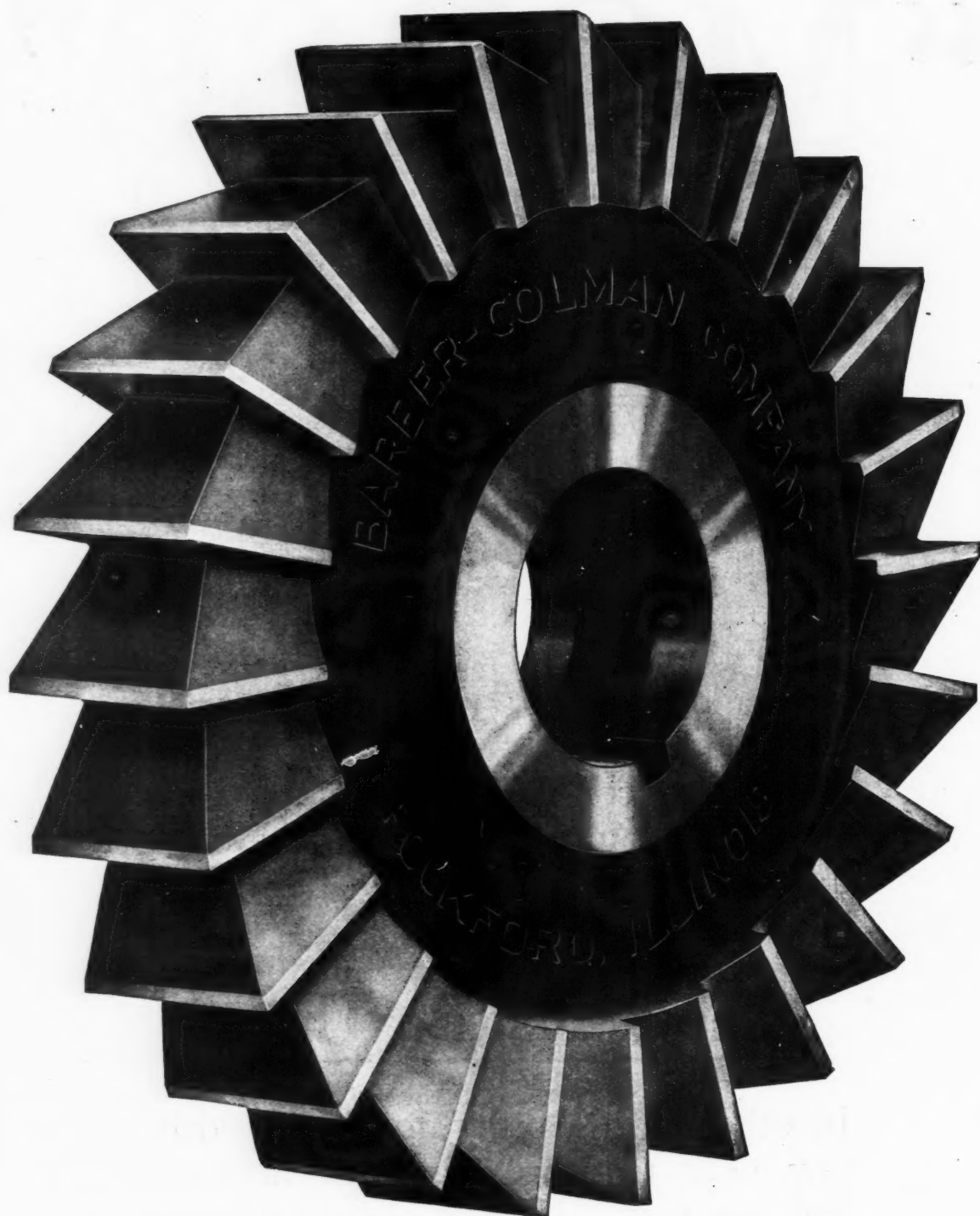
Will help you keep your production up to the mark you have set. Many times they will enable you to set a new and a higher mark. They have the accuracy to do good work and the stamina to continue doing it. With a reasonable amount of care they will turn out almost unreasonable results but to do this

They Must Be There.

In other words, order to-day the drills you need to-morrow and the next day and the next. Even a slight overstock is less expensive than idle machinery, and when you want a drill these days you want it.

Catalog on Request.

MORSE TWIST DRILL & MACHINE CO.
NEW BEDFORD, MASS., U. S. A.



We guarantee our Milling Cutters absolutely, in
respect to material, workmanship and accuracy

BARBER-COLMAN COMPANY

ROCKFORD

ILLINOIS, U. S. A.

◆ And Now ◆
There's An EZY-OUT Set
for Every Shop

YOU, who have been unable to obtain an EZY-OUT Screw Extractor Set small enough or large enough for your specialized needs, will be glad to hear that there are now

TWO ENTIRELY NEW
EZY-OUT Screw Extractor Sets

TWELVE SIZES IN ALL

(Patented 1914)

Q One of the three sets illustrated on the right contains the first real solution to the broken screw problem *in your shop*.

THE MODERN METHOD

HENCEFORTH, when a screw breaks, don't waste time fussing with files and punches — just drill a hole in the broken section, insert an EZY-OUT Screw Extractor, slip on a tap wrench and twist — and out will come that screw in a fraction of the time hitherto required, and without injury to the threads.

SOONER OR LATER YOU WILL FACE
AN URGENT NEED FOR THIS TOOL

Q Why wait until then and risk the delay, loss and embarrassment that this unfilled need will incur? Ask us for our booklet descriptive of these new sets and the three extra large sizes not illustrated here, or better yet, choose your set and order it from your dealer today.



TWIST DRILL COMPANY

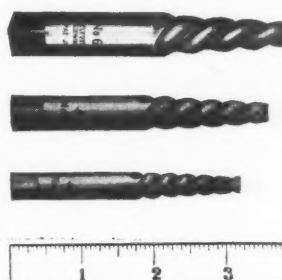
NEW YORK CLEVELAND CHICAGO

SET NUMBER 15



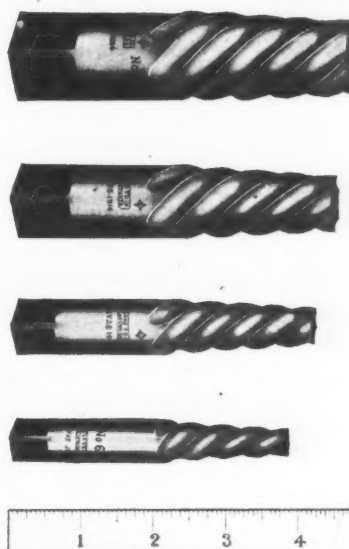
Price — \$2.25 F. O. B. Cleveland

SET NUMBER 17



Price — \$1.75 F. O. B. Cleveland

SET NUMBER 16



Price — \$4.00 F. O. B. Cleveland

Entire Drive Runs in Oil

One pair of bevel gears and one spiral pinion, all rigidly mounted and running in oil, constitute the driving mechanism of spiral-geared

Gray Planers

*Write for catalog describing
all of their exclusive features*

The G. A. GRAY CO.
CINCINNATI, OHIO



Gray
Planers

"Made for
those who want
the Best"



Rigid and Accurate The "Cleveland" Open Side Planers

will handle any and all classes of work equal to that done on any planer of any type.

With fewer working parts, it is the
SIMPLEST PLANER ON THE MARKET.

All gears, in drive, except bull gear and its pinion are enclosed and run in oil.

Almost fool-proof.

May we send you a catalog?

CLEVELAND PLANNER WORKS

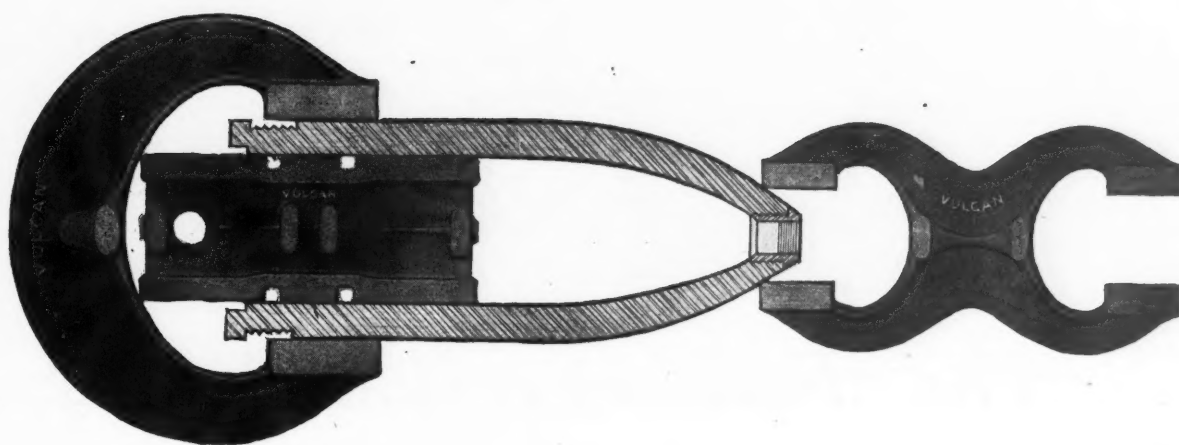
JAMES G. DORNBIRER
GEO. W. FORD

**3150-3152
Superior Ave.,
CLEVELAND,
OHIO, U. S. A.**

America Needs Gauges Now!

Some must be made separately
with infinite pains, but

Williams' "VULCAN" Drop-Forged Caliper Gauges Await Orders



for Internal, External and Eternal Service

They can't be sized until detailed to their
specific tasks. So that is your duty.

"We Forge, You Finish"

Every tool maker knows that "VULCAN"
Gauges save much time needed to pro-
duce hand-made gauges for the work
they can do as well. That time is now
priceless. Wherever our Gauge can serve

ENLIST A "VULCAN"

Western Office and
Warehouse:



32A South Clinton St.
Chicago, Ill.



The "Feel" of a Good File

Did you ever watch a really capable mechanic test a file? He has a way of passing a sensitive thumb over its jagged surface. Instinctively, unfailingly, he thereby determines whether it is fit for use.

This man invariably chooses NICHOLSON FILES. He never buys blindly. He can "feel" that a NICHOLSON FILE is right. He can "feel" its sharp, keen-cutting teeth, arranged in rows of perfect uniformity. There is no doubt in his mind. He buys NICHOLSON. He makes sure of satisfaction.



Our catalog and copy of "File Philosophy" will interest you. Write for them today.



NICHOLSON FILE CO., Providence, R. I.

NICHOLSON

The Cleveland Milling Machine Co. PROFILE GRINDER

Is used to grind concave and convex cutters, cutters for fluting drills, cutters that are irregular but having a number of true curves, accurately rounding the corners on side mills and face mills, formed tools for lathes, planers and shapers.

The maximum radius that can be ground is 3 inches either convex or concave up to 12" diameter.

The center cut shows a variety of formed cutters accurately ground on this machine. This, however, is only a small percentage of the uses that this tool can be put to. Users are finding it indispensable in the tool room.

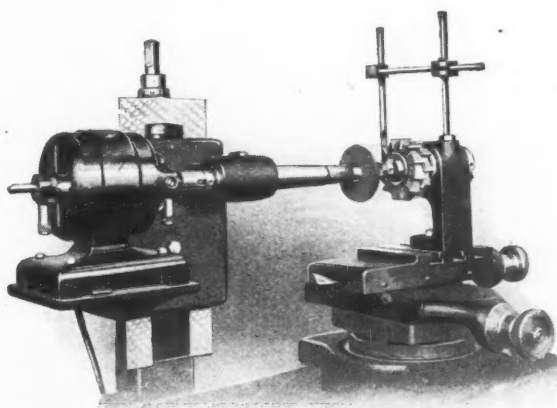
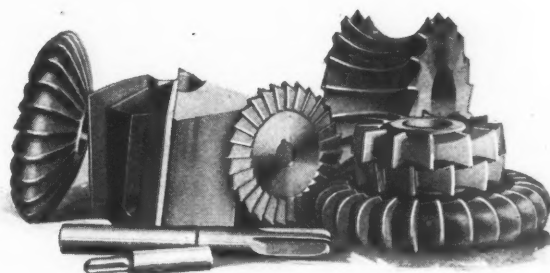
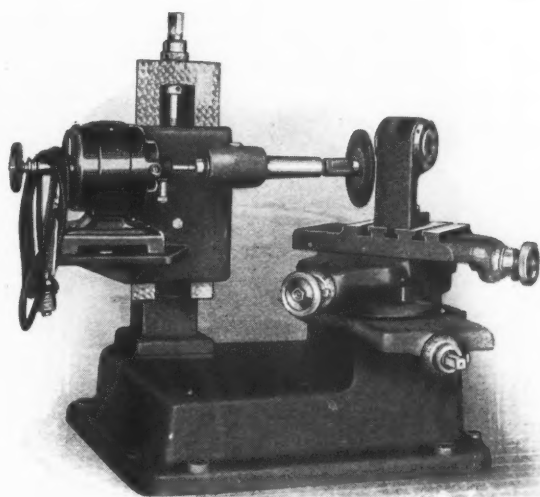
The wheel carrying spindle is direct connected onto the motor shaft and has adjustable bronze bearings and carries a wheel 4" diameter, $\frac{1}{4}$ " wide, $\frac{3}{8}$ " hole.

A type "D" Universal Dumore motor is furnished with ten feet of wire and lamp socket.

Complete equipment is furnished for all classes of work.



Immediate delivery if you get your order in now.



The Cleveland Milling Machine Co.
18511 EUCLID AVENUE CLEVELAND, OHIO

CARD TAPS

Taps of Uniform Dependable Quality

the one thing to consider in buying taps is quality; the accuracy and finish of your work depend on it—it governs tool service and tool costs.

Card Taps insure "Card Quality"—the quality that made Card Tools leaders from the start—the quality that distinguishes every tool in the Card line.

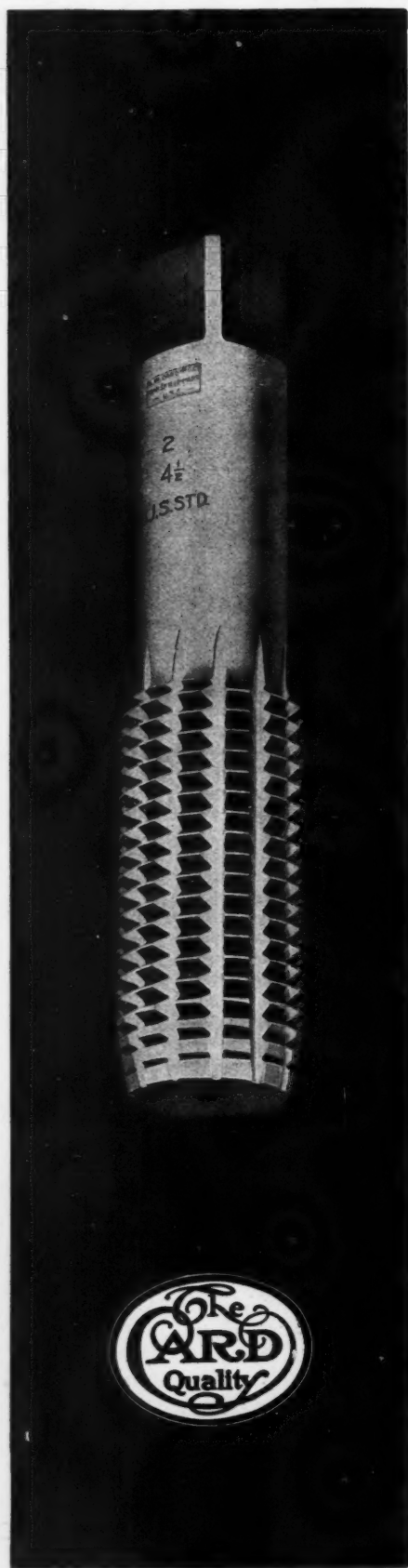
Actual experience with Card tools proves their economy. Catalog No. 28 gives full list. Send us a trial order.

**S. W. CARD
MFG. CO.**

MANSFIELD MASS.

New York Office, 62 Reade St.

European Agents: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester and Glasgow; Markt & Co., Ltd., Paris; Fenwick Freres & Co., Turin; Ignacz Szekeley, Budapest; V. Lowener, Stockholm, Copenhagen, Christiania; R. S. Stokvis and Zonen, Ltd., Rotterdam; R. S. Stokvis & Fils, Brussels; Andrews & George, Yokohama, Tokio, Osaka; J. Lambercier & Co., Geneva; R. D'Aulignac, Barcelona, Spain; Arthur Kayser, Berlin, S. W. 68, Oranienstr., 126, Germany.



A United States "Portable" Does This Job as Well as a Massive Radial—

And at a
Fraction of
the Cost.

We make
United States
Portable Drills
and Grinders in
types and sizes to
meet all require-
ments. We shall
be glad to
demonstrate their
advantages.
Let us send our
catalog.

A practical and economical application of a U. S. Portable Electric Drill is shown below. At the plant of Charles S. Lewis & Co., St. Louis, Mo., they drill holes in massive pump bases in the manner shown. Over a platform on which the castings rest a traveling carriage mounts a U. S. Type G F Radial Drill. During the drilling operation the carriage is rigidly clamped in place and the holes are quickly put through the work. After drilling, the holes are tapped and the operation is complete. The advantage of handling work in this way is obvious. U. S. "Portables" have many possibilities in any plant. Think it over.

The United States Electrical Tool Co. 6th Ave. and Mt. Hope St. CINCINNATI, OHIO

New York Office, 50 Church
Street, New York City.
Chicago Office, 549 West Wash-
ington Boulevard.
St. Louis Office, 610 Commercial
Building.

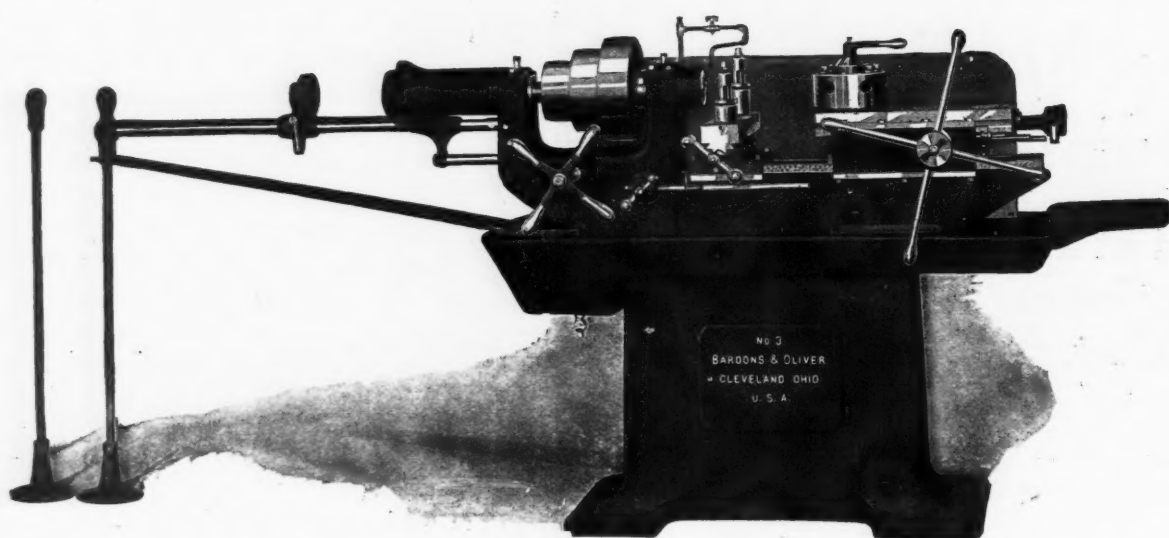
Boston Office, 12 Pearl Street.
Kansas City Office, 3119 Holmes
Street.
Detroit Office, 1410 Dime Bank
Building.
Philadelphia Office, The Bourne

STOCK CARRIED IN BRANCHES



Bardons & Oliver

TURRET LATHE

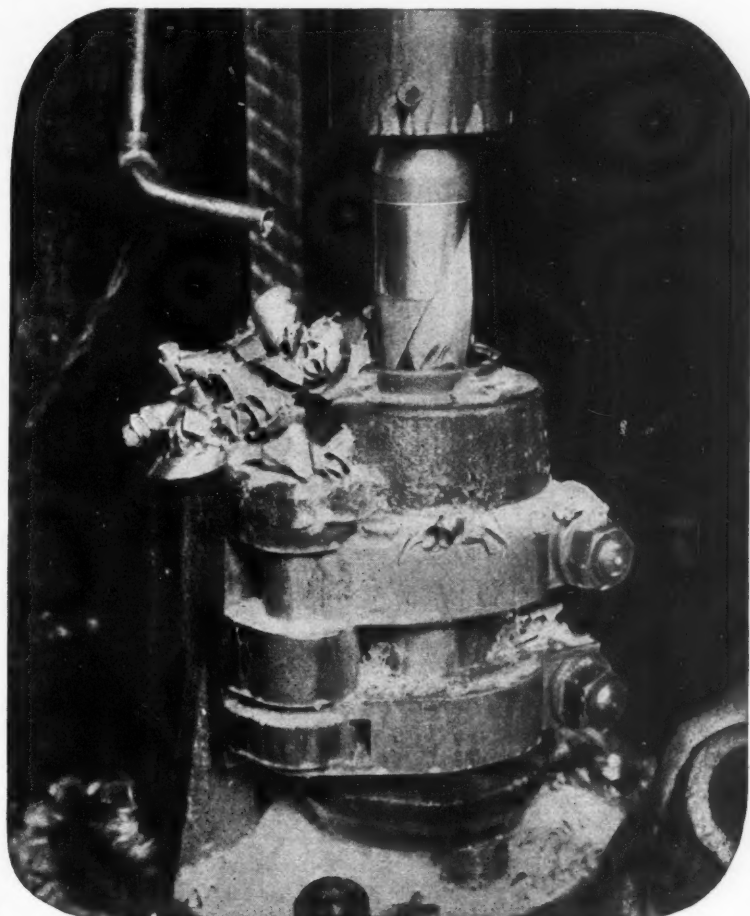


Conveniences That Speed Up Production

The Bardons & Oliver Turret Lathe is a machine of exceptional ease of manipulation—and any manufacturer knows that convenience is of really great importance. In these lathes the tooling system is so simple and complete that setting-up entails little loss of time, output naturally increasing in proportion as the maximum possibilities of the machine are utilized.

Operating facilities enable Bardons & Oliver Lathes to turn out an enormous amount of accurate work under ordinary conditions, and are a guarantee against any tendency to slow up under forced draft. Production never fails to jump wherever these lathes are installed. Unless you are familiar with their possibilities your output is probably far from what it should be. Let us send full description of the lathe and tell you where you can see them in action.

BARDONS & OLIVER
CLEVELAND, OHIO



**Standing
Up—**

***Under
Fifteen
Thousand
Pounds***

A 1 $\frac{1}{4}$ " drill should not break under *ordinary* conditions. But have you any idea of the tremendous stress it often undergoes in eating its way through the metal?

Add fifteen thousand pounds of vertical thrust to the grinding resistance and you have a fair idea of the kind of material and skill that make Union Twist Drills stand up.

Cutting coolly and rapidly, and with minimum wear, is a result that can come only from the broadest knowledge of tool requirements, together with the most scientific methods of material selection and manufacture.

*The Union catalog also shows the full line
of Union Tools—shall we send a copy?*

UNION TWIST DRILL CO.
ATHOL MASSACHUSETTS



THE FINAL PROOF



THE FELLOWS GEAR SHAPER

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, England;

F OF ACCURACY

Don't fool yourself. You can't cut an accurate and efficient helical gear with an inaccurate cutter. Be the gear cutting machine ever so accurate, the cutter is the final arbitrator.

And speaking about cutter control, this must be positive and rigid, not flexible. If not positive, the best cutter that was ever made is no better than the worst.

In July Machinery we illustrated and explained the helical control mechanism which is used on the Fellows Helical Gear Shaper, and which guides the cutter in a positive and rigid manner.

The designer on the opposite page is now being shown the Helical Gear Shaper Cutter—the *secret of perfect helical gears*. This cutter has the involute curves of the teeth generated by a grinding process after hardening in the same manner as the Gear Shaper Cutter used for cutting spur gears.

This Point Is Important

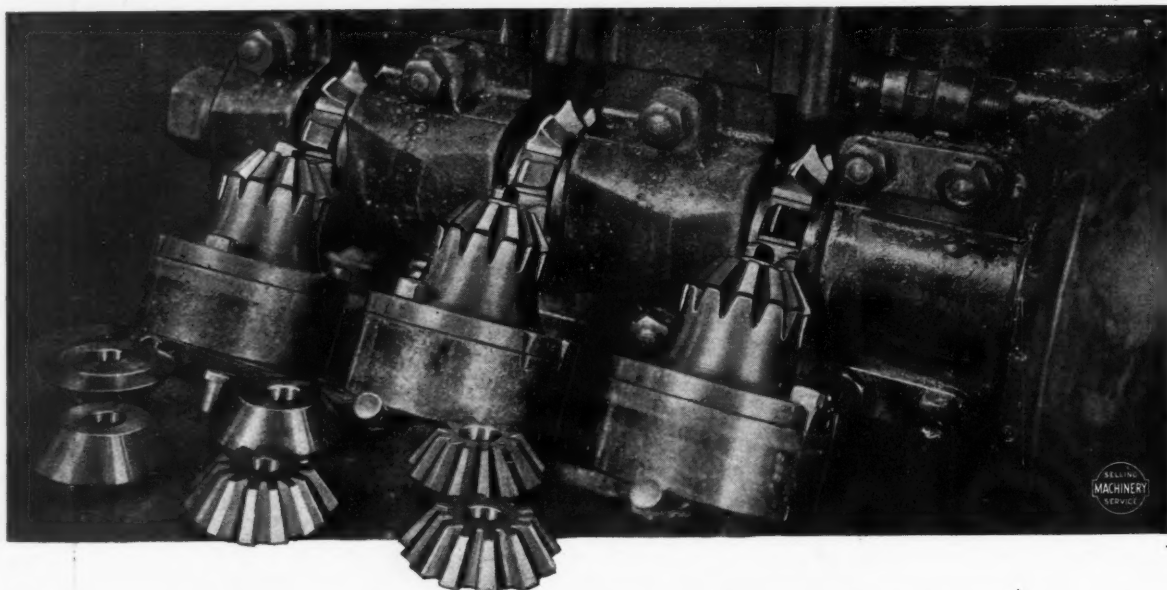
With the Helical Gear Shaper there are no "gears" to calculate. The feed of the cutter and the helix angle produced have no connection whatsoever. There is no jumping from pillar to post only to find in the end that you cannot get the helix angle you want. It is just as easy to cut a helical gear on the Gear Shaper as it is a spur gear, and the cutting of a spur gear is simplicity itself. Ask any owner of the Gear Shaper.

It is no exaggeration to say, therefore, that the Fellows Helical Gear Shaper has taken the "H—I" out of Helical and the "Myst" out of Mystery.

Don't fuss and worry along with the "old methods" any longer. There is a better way—the Gear Shaper way. Write now for our booklet, "The Fellows Helical Gear Shaper," which explains this most interesting machine.

COMPANY, Springfield, Vermont, U.S.A.

Paris, France, and Spain; Milan, Italy; Yokohama, Japan; Calcutta, India.

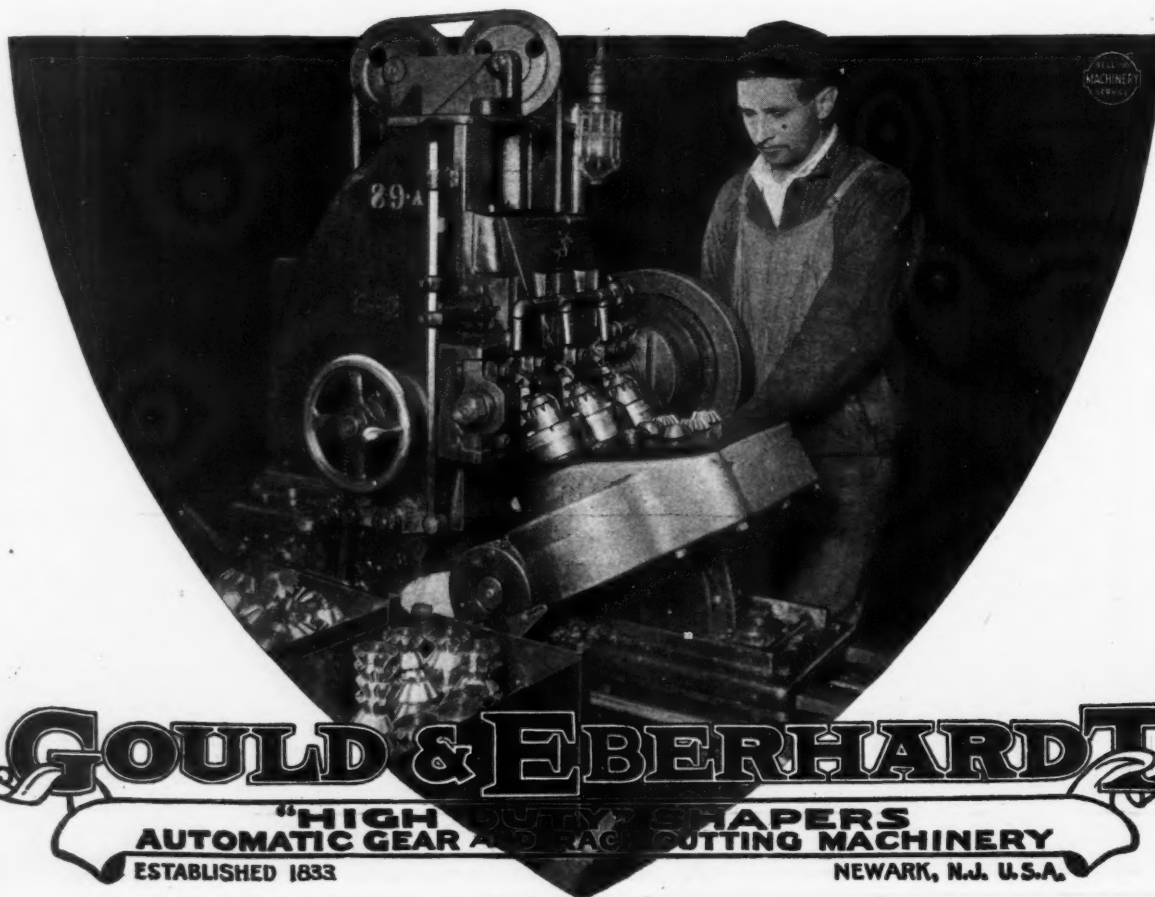


Roughing Out Bevel Pinions on a G & E Multiple Spindle Gear Cutter

An average production of 300 pinions per ten hour day is produced on this machine—Pinion is 12 tooth, $\frac{6}{8}$ pitch, $\frac{3}{4}$ " face made of cold rolled steel.

In cutting 3 pinions at one time we treble ordinary production—Let us help you on your particular work with our experience.

Send us your blue prints. Increase your production.



GOULD & EBERHARDT
 "HIGH DUTY SHAPERS
 AUTOMATIC GEAR AND GEAR CUTTING MACHINERY
 ESTABLISHED 1833 NEWARK, N.J. U.S.A."

Prestwich Fluid Gauge

Only One Mechanical Movement

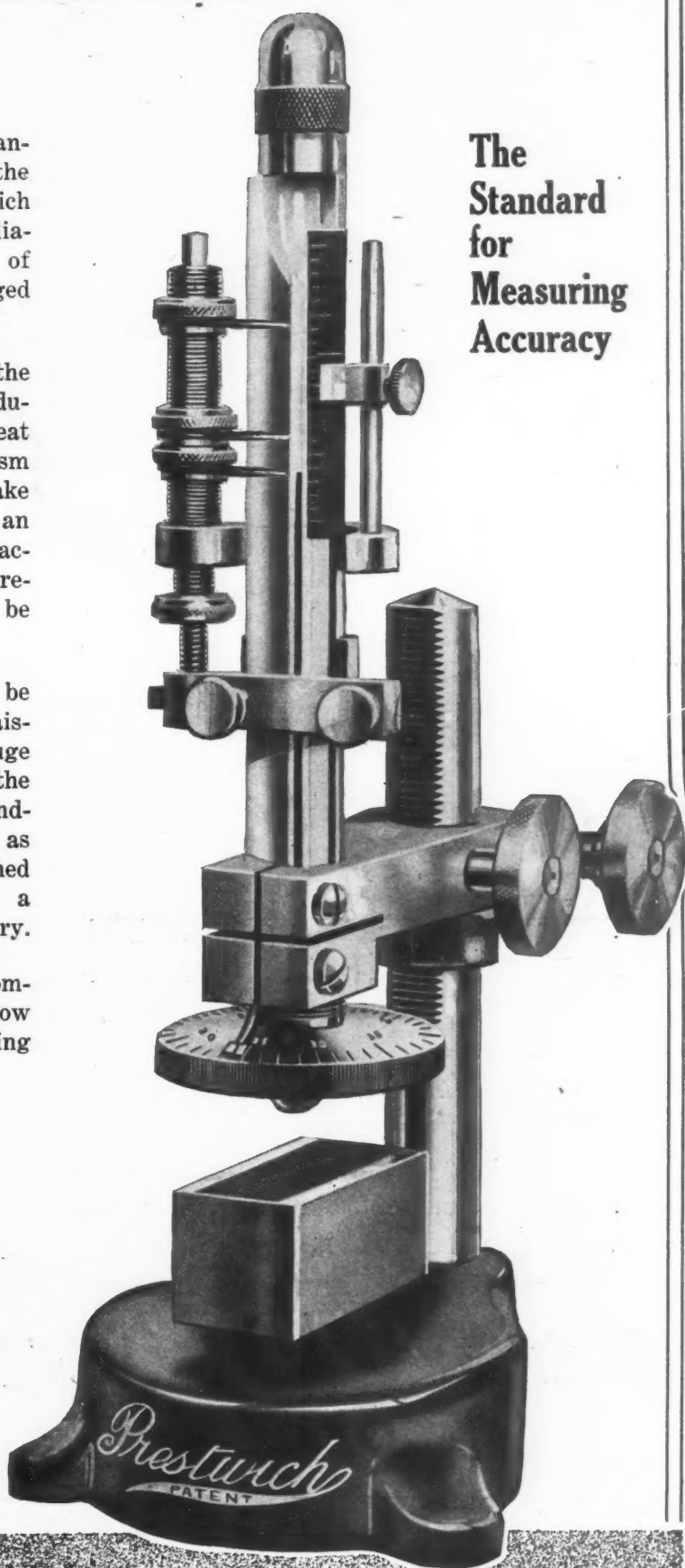
THERE'S just one mechanical movement in the action of the Prestwich Fluid Gauge—that of the diaphragm, the displacement of which by the object being gauged runs up the liquid in the tube

The simplicity of this action, the readiness with which fine graduations can be read, the great durability of the mechanism and its wide adaptability make the Prestwich Fluid Gauge an ideal instrument for manufacturing purposes—for use wherever quantities of work must be gauged to close limits.

The range of work that can be gauged is remarkable. By raising or lowering the gauge column on its standard the measuring anvils can be extended or brought close together as required. The object is pushed between the anvils—and a glance at the level tells the story.

We'll be glad to send the complete story and show you how to speed up your measuring methods. Write us.

The
Standard
for
Measuring
Accuracy



*Manufactured under license for
the United States and Canada by*

Coats Machine Tool Co.

INCORPORATED

30 Church Street NEW YORK



Peerless
CARS
and

Two High Grade Products

Each a "Top-Notcher"
in Its Particular Field

Assembled, tested, supplied with "juice" and cranked for a run, the Peerless looks, and is, a quality car from stem to stern. Geometric Tools—Die Heads and Collapsing Taps—help make it so. They contribute threads of the highest grade, accurate, finely finished threads, cut with remarkable speed and economy. It happens to be an internal threading job we are showing this time—differential cages in which the hole is $2\frac{5}{8}$ " diameter, and the U. S. S. 16 pitch thread is $\frac{5}{8}$ " in length. Not spectacular threading this; but interesting to the production investigator because it shows how a wideawake concern secures results.

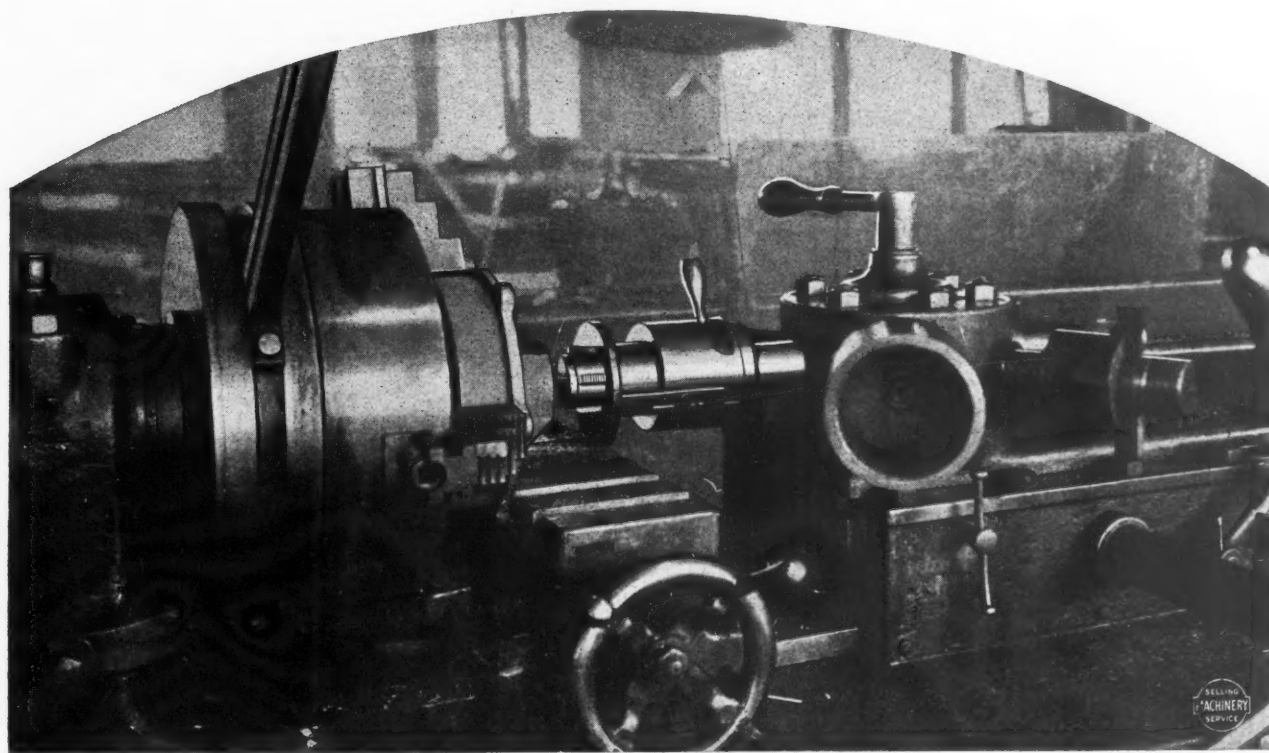
THE GEOMETRIC TOOL COMPANY

CHICAGO OFFICE:

REGULAR AGENTS: The Chas. A. Strelinger Co., Detroit, Mich.; Hill, Clarke & Co., Inc., Boston; Vandyck Churchill Co., New York and Philadelphia; Brown & Zortman Machinery Co., Pittsburgh, Pa.; The E. A. Kinsey Co., Cincinnati, O.; Strong, Carlisle & Hammond Co., Cleveland, O. PACIFIC COAST: General Machinery & Supply Co., San Francisco, Cal.; Perine Mch. Co., Inc., Seattle, Wash. CANADA: The A. R. Williams Machinery Co., Ltd., Toronto, Winnipeg and St. John, N. B.; Williams & Wilson, Ltd., Montreal.

Geometric DIE HEADS

Geometric Tools are old timers with a record for universally efficient, economical service. They cut long, short, fine, coarse, tapered, inside or outside threads. Let us show how profitably they can cut threads for you. *Write for the Geometric Catalog.*



NEW HAVEN, CONNECTICUT, U. S. A.

545 W. Washington Blvd.

FOREIGN AGENTS: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne, Glasgow. Donauwerk Ernst Krause & Co., Vienna. V. Lowener's Maskinforretning, Sverre Mohn, Norway. Bevan & Edwards Pty., Ltd., Melbourne, and White & Rae, Sydney, Australia. Andrews & George, Tokyo, Japan. Also all manufacturers of Screw Machines and Turret Lathes.



Close Accuracy Required on Bearing Races

*Heald Grinding
Is Uniformly Accurate*

The hole in the small bearing is tapered $12^{\circ} 6''$ and is 1.488" at the large end. The amount of stock removed is .012" and the grinding limits, .001" plus or minus. The output is one piece per minute per machine—60 per hour. Such a rapid and economical output is appreciated by the production man.

THE HEALD MACHINE COMPANY

20 New Bond Street

WORCESTER, MASS., U. S. A.

NEW YORK,
839 Singer Bldg.

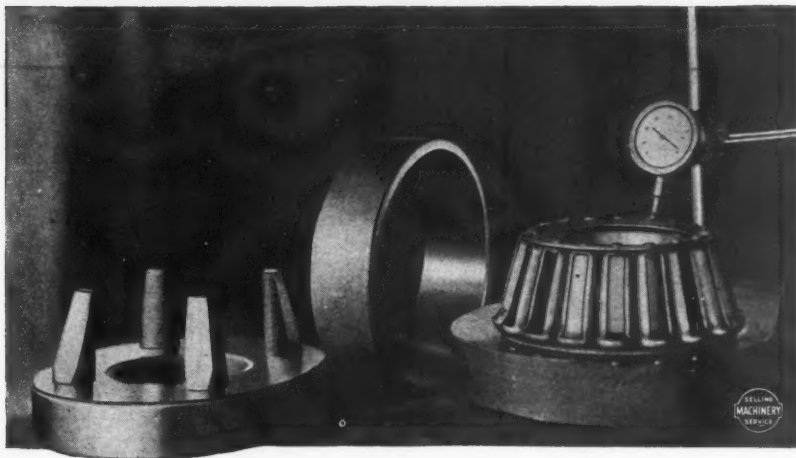
CHICAGO,
24 So. Jefferson St.

DETROIT,
303 Majestic Bldg.

CINCINNATI,
602 Provident Bank Bldg.

CLEVELAND,
710 Engineers Bldg.

Good Production Secured with Heald Grinders



We are showing bearing races ranging from $1\frac{3}{4}$ " to 11" diameter, close limit grinding of the kind that Heald Grinding Machines handle remarkably well.

There are 36 Heald Grinders used in the production of Bock Bearings, at the Bock Bearing Company's plant, Toledo, Ohio—36 thoroughly satisfactory machines.

*Our Engineers will be glad to study your requirements.
For quick service write the nearest branch office.*

ALD

The large bearing has an inside taper of $18^{\circ} 30' 6''$, is 10.233", plus or minus .001", at the large end, and has .048" stock removed. They come off the machine at the rate of four pieces per hour, as accurately ground as you could wish, "passed by the censor," who uses a test gauge on every bearing that comes through.

PACIFIC COAST AGENTS: Eccles & Smith Co., San Francisco and Portland. Smith-Booth-Usher Co., Los Angeles.

FOREIGN AGENTS: Alfred Herbert, Ltd., England, Italy, France, Switzerland, Spain and Portugal. F. W. Horne Co., Japan. Wilh. Sonesson & Co., Ltd., Sweden, Denmark and Norway. Post van der Burg & Co., Holland. Iznosskoff & Co., Russia.



SKF

**Look for the mark SKF on the
Machine Tools you build and buy**

In every industrial center throughout the world the mark SKF on a ball bearing is the symbol of excellence. Its meaning is not limited. It stands not only for bearing quality and service, but also for unique design and for the brain, the skill and the spirit of the SKF organization. It stands for excellence—in all ways, in all nations, at all times.

BALL BEARINGS

SKF BALL BEARING CO.

SKF BALL BEARING
CO. of California, Inc.
San Francisco.



A Battery of
"American" Lathes,
SKF equipped

SKF

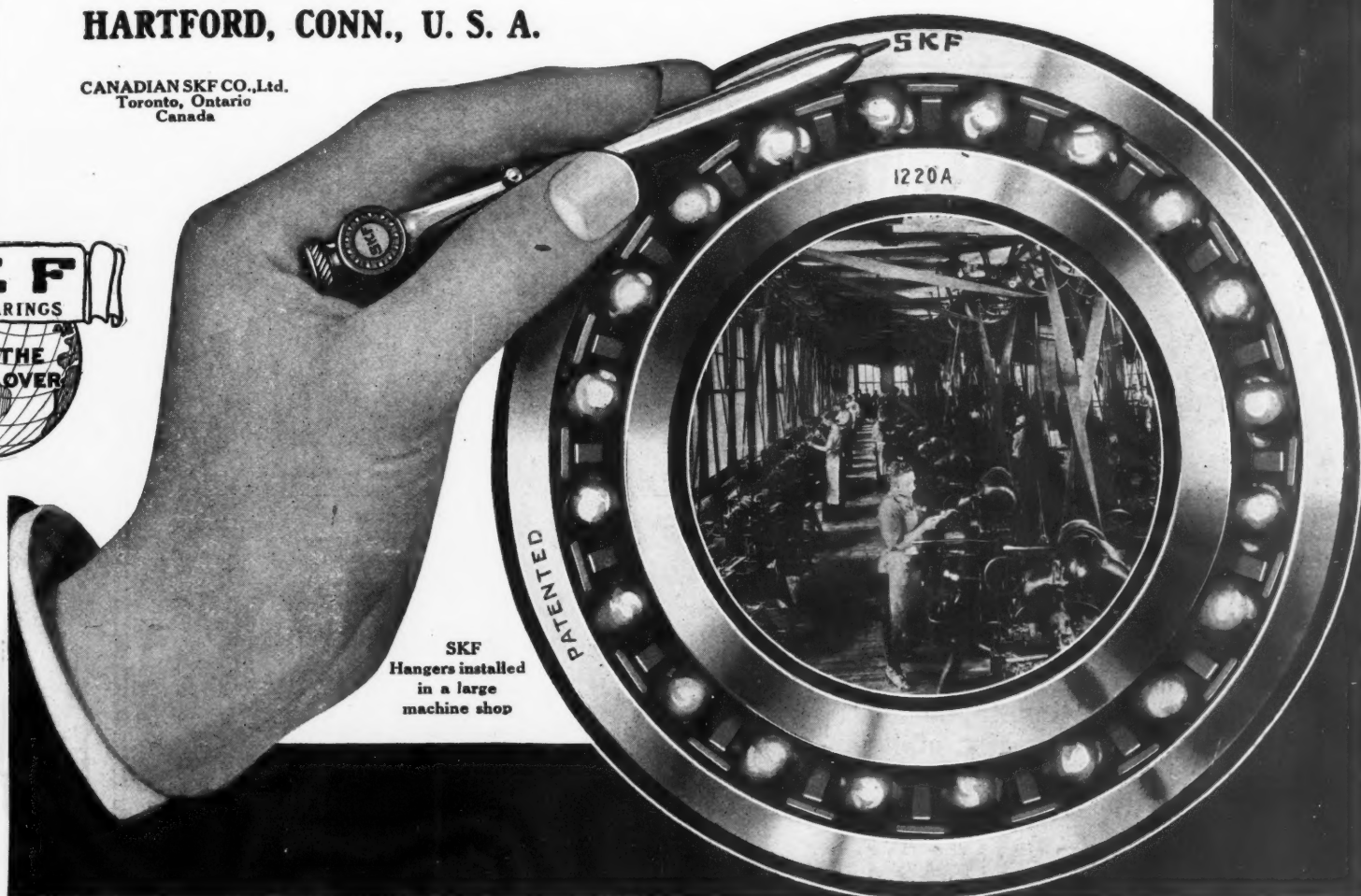
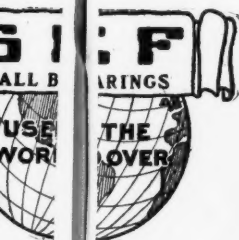
**Strong, Dominating, Steadfast, SKF
Quality is one with its Fame**

The machine tool user or manufacturer who demands quality—who wants materials and workmanship of the highest standards—will find SKF adequate to his most exacting requirements. No effort is spared, no precaution omitted, to maintain the excellence for which SKF is famous. The mark SKF is more than the name of a ball bearing—it is the visible symbol of excellence. This is why it stands at the forefront of machine tool progress.

BALL BEARINGS

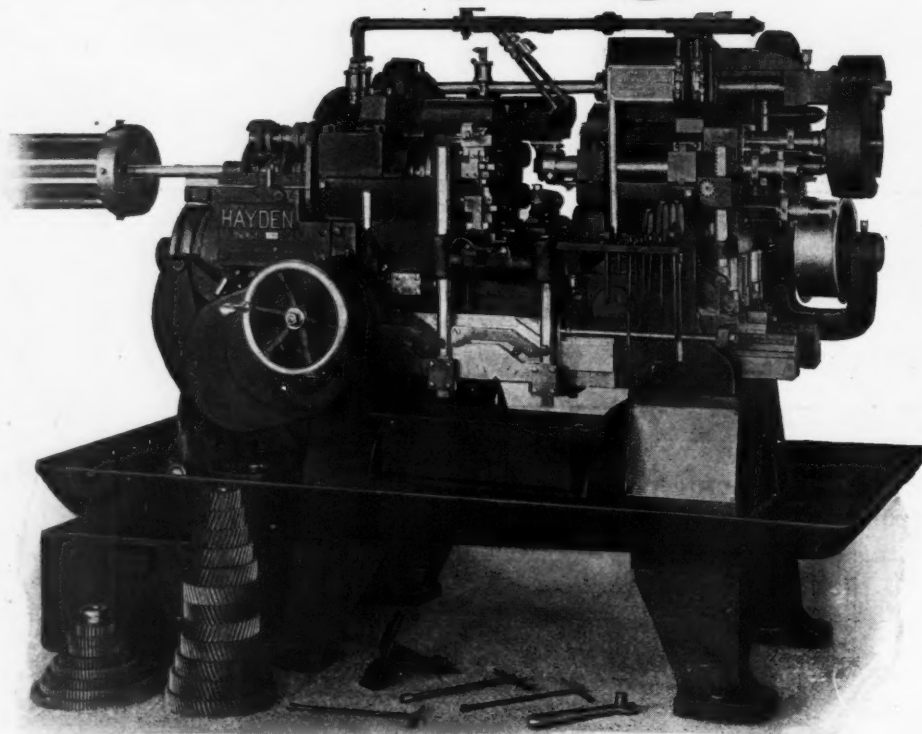
HARTFORD, CONN., U. S. A.

CANADIAN SKF CO., Ltd.
Toronto, Ontario
Canada



SKF
Hangers installed
in a large
machine shop

The Hayden Automatic From Any Angle



STUDY this machine from any viewpoint — investment, maintenance, operating costs, quantity or quality of output—and you'll understand why the Hayden Automatic always comes up for discussion when machines of this class are under consideration.

We claim that the Hayden Automatic is the superior of all other machines of its class, *in every respect*. And the net result is the greatest possible production at the lowest costs. These are strong claims; but we have proved them to many men and are ready to prove them to you—in any manner you may desire.

*Send for the catalogue
and the whole story.*

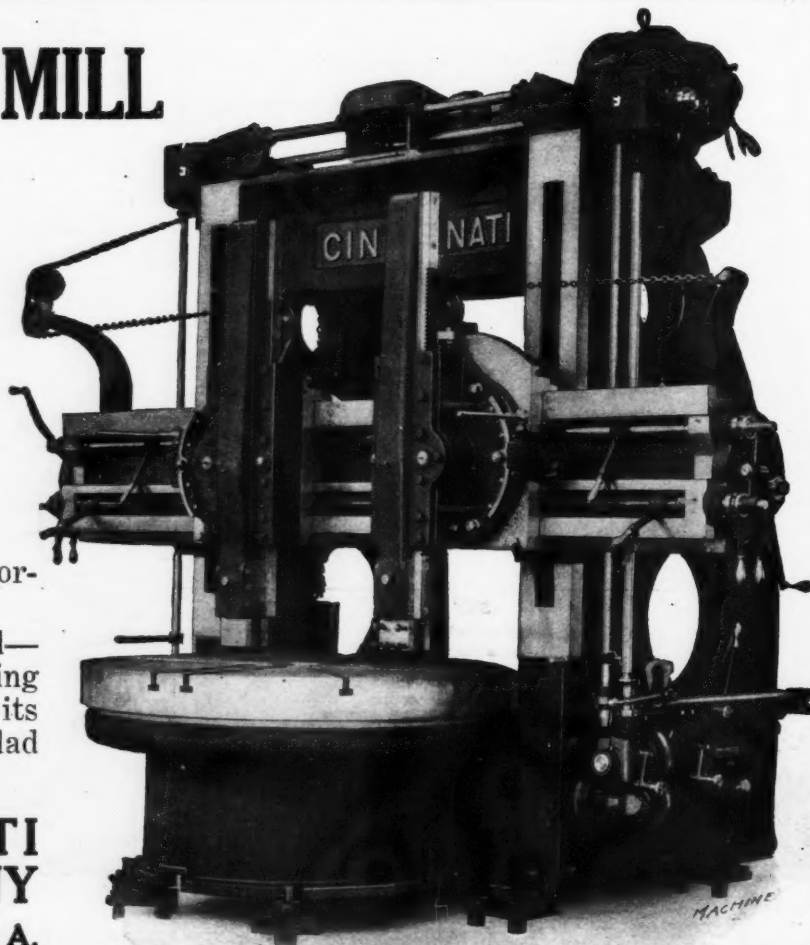
CINCINNATI AUTOMATIC MACHINE CO., Oakley, Cincinnati, Ohio, U.S.A.

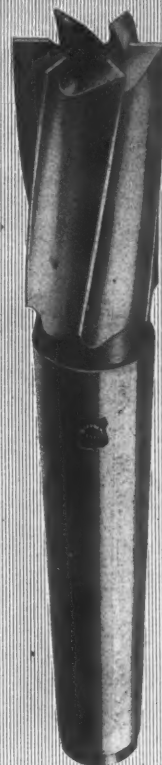
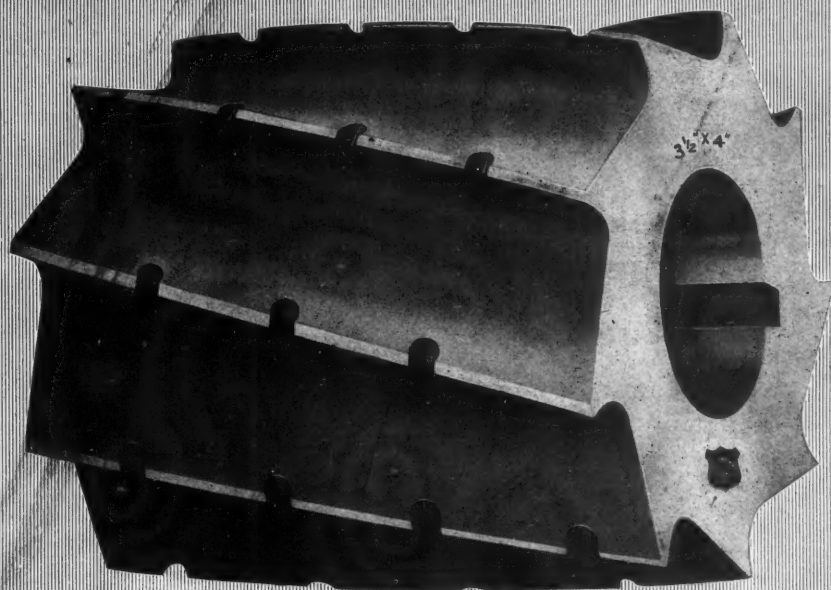
THE BORING MILL

The modern boring mill is more than its title indicates. It is a manufacturing tool—big, powerful, yet easy to operate, its special field being the machining of work of large diameter. It is accurate as well as powerful—carries wide forming tools and finishes such work as automobile tire molds to extremely close limits. It is carefully designed and thoroughly well built.

Such is the modern boring mill—such is the Cincinnati Boring Mill. No better machine of its class can be built. We'll be glad to prove it.

**THE CINCINNATI
PLANNER COMPANY**
CINCINNATI OHIO, U.S.A.





SHIELD BRAND MILLING CUTTERS WITH WIDE-SPACED TEETH

THESE cutters are desirable where a large amount of metal is to be removed.

They will be found especially efficient in high power milling machines.

We make them in all styles and sizes.

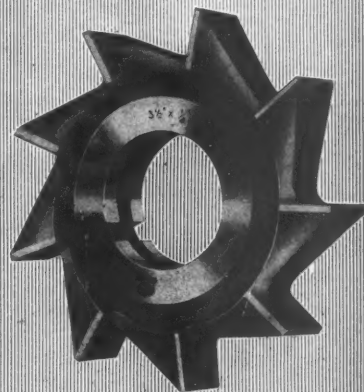
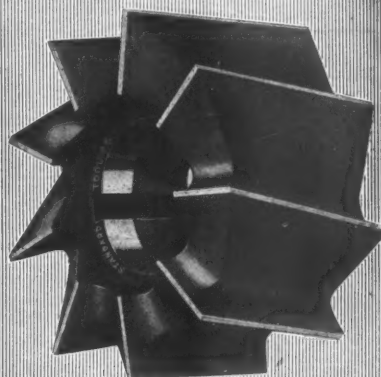
Write for further information.

THE STANDARD TOOL CO.

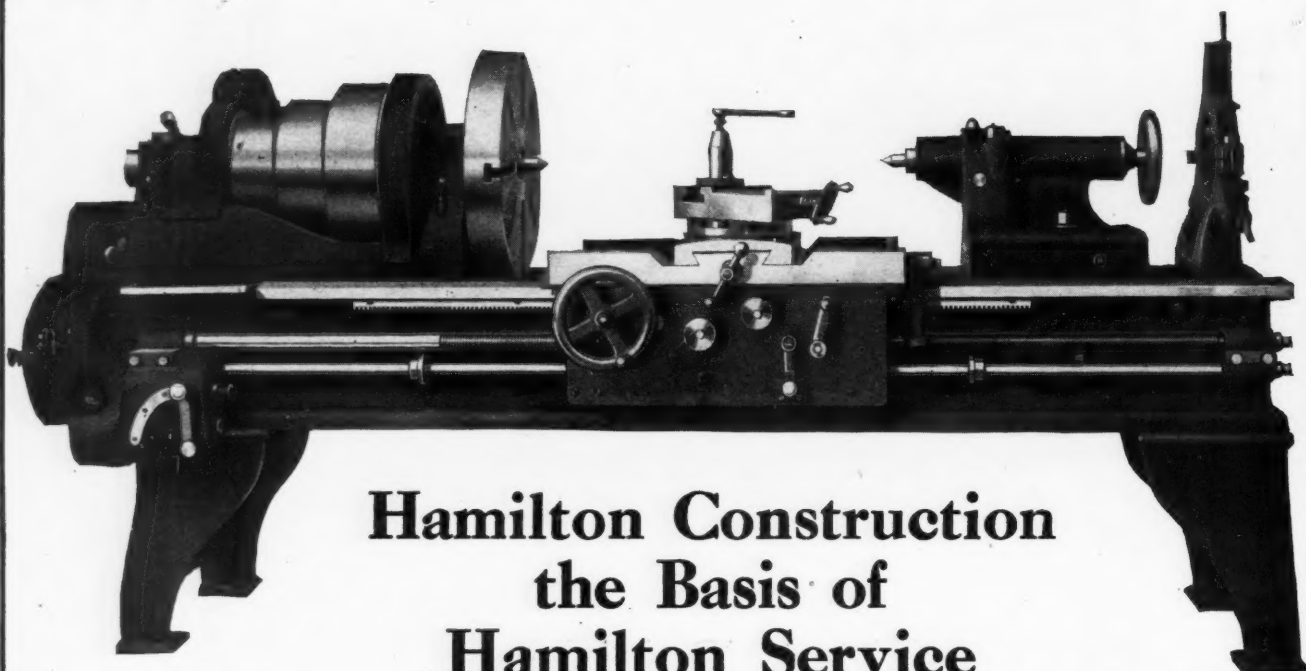
CLEVELAND—SIXTH CITY—U. S. A.

New York Store at 94 Reade Street
Chicago Store at 552 W. Washington Blvd.

London—C. W. Burton, Griffiths & Co. Paris—Burton Fils.
Geneva—J. Lambercier & Co. Brussels—Honore Demoor & Cie.
Copenhagen—Nienstaedt & Co. Tokyo—F. W. Horne.



"HAMILTON"



Hamilton Construction the Basis of Hamilton Service

We have built Hamilton Lathes on the theory that as a machine is made so will it perform. We wanted accuracy, so we centered on rigidity—made the Hamilton bed wide, deep, with heavy bracings, and backed it up with a headstock of massive and scientifically correct proportions. We wanted speed, so we provided tremendous driving power and operating helps of the simplest and most convenient kind. We have turned out a line of lathes that run second to none for capacity to turn out high grade work fast and keep everlastingly at it. The Hamilton spindle is forged crucible steel, bored its entire length, and accurately ground to size. Carriage is large, is securely gibbed front, center and back, scraped to solid bearing on bed its entire length and provided with power longitudinal and cross feed. All shafts and studs, lead screw, feed rod, and all rack and pinions are of high grade steel. All gearing accurately cut from the solid. All feeds are reversible from the apron.

Your chief need just now is reliable equipment. We can take care of your Lathe and Planer needs. Write for details.

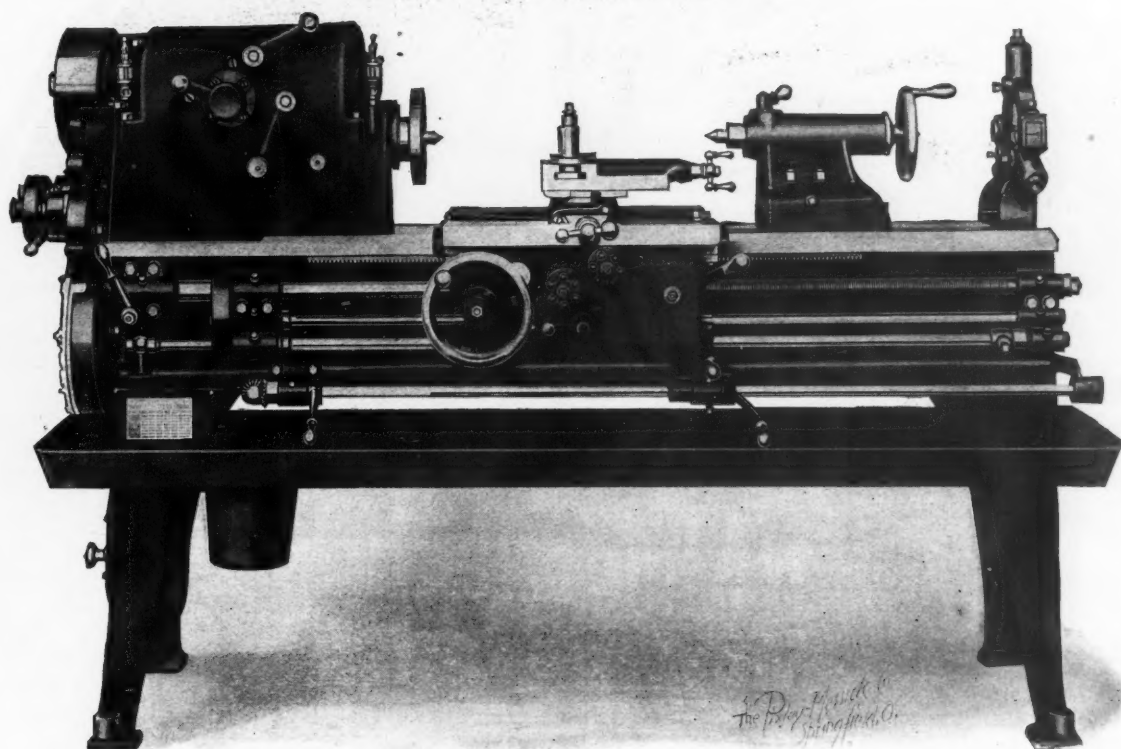


THE HAMILTON MACHINE TOOL CO. HAMILTON, OHIO, U. S. A.

DOMESTIC AGENTS: T. Crowther & Co., Inc., Boston, Mass.; M. D. Farnum, Springfield, Mass.; Garvin Machine Co., New York; Strong & Hery Co., Rochester, N. Y.; Sherritt & Stoer Co., Philadelphia, Pa.; Laughlin-Barney Mch. Co., Pittsburgh, Pa.; Cullen Mch. Co., Cleveland, O.; Osborne & Sexton Mch. Co., Columbus, O.; Wolverine Machinery & Supply Co., Detroit, Mich.; Stocker-Rumely-Wachs Co., Chicago, Ill.; Thomson Tool & Supply Co., Indianapolis, Ind.; W. C. Johnson & Sons Mch. Co., St. Louis, Mo.; F. E. Satterlee Co., Minneapolis, Minn.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; General Machinery & Supply Co., San Francisco, Cal.; Herberts Machinery & Supply Co., Los Angeles, Cal.; M. J. Walsh Mch. Co., Milwaukee, Wis.; Textile Mill Supply Co., Charlotte, N. C.; Cotton States Belting & Supply Co., Atlanta, Ga.; Oliver H. Van Horn, Inc., New Orleans, La. CANADIAN AGENTS: H. W. Petrie, Ltd., Toronto, Ont.

SPRINGFIELD MACHINES

Set New Standards of Efficiency



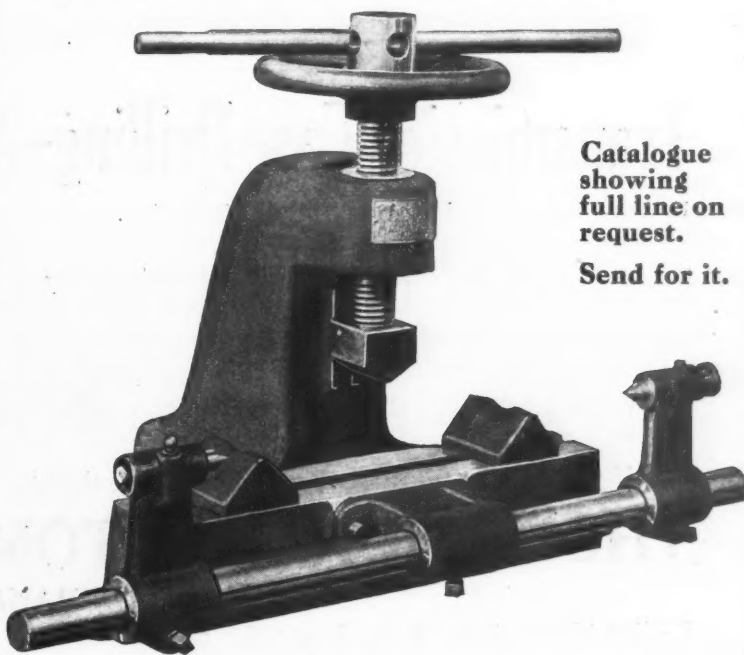
Springfield Machines are not pace followers—they are pace setters and bring high production, high efficiency and remarkable range and capacity into your shop. This powerful Springfield "Ideal" 14" x 6' Single Pulley Engine Lathe is heavy, compact and practically noiseless. The design allows the use of short shafts of large diameter, which effectually frees the lathe from vibration and chatter. Thirteen gears give twelve speeds and you reach the desired speed at once without having to go through the whole series to reach it. From headstock to base this machine is made to give greatest service and value. It's more than a lathe—it's a standard.

The Springfield Bench Straightening Press and Centers are made in three sizes for quick and accurate work. They are especially valuable in factories where there are crankshafts and camshafts to straighten and where the result must be correct to promote perfect action of the machines of which the straightened shafts form a part. Work is not marred as the points of the set screw are brass covered. These are useful and competent tools and are another example of Springfield value.

The Springfield Machine Tool Company

631 Southern Avenue
Springfield Ohio, U. S. A.

Manufacturers of Springfield Lathes and Shapers



Catalogue
showing
full line on
request.

Send for it.



Transmission Case Drilling—All on the NATCO

In the operation shown twelve $13/32$ -inch drills are used. The thickness of material is $1\frac{1}{2}$ inch. No lubrication. The operator completes this operation at the rate of thirty cases per hour. **All the drilling on this transmission case is done the NATCO way.** There are thirty-four holes in all, divided up into six operations.

The Durston Gear Co., Syracuse, New York, has another smaller NATCO drill—and each has been a profitable investment. The work done is performed at production figures as good as that quoted for this job—and the exclusive NATCO feature, independent speed adjustment for each drill, is one of the reasons.

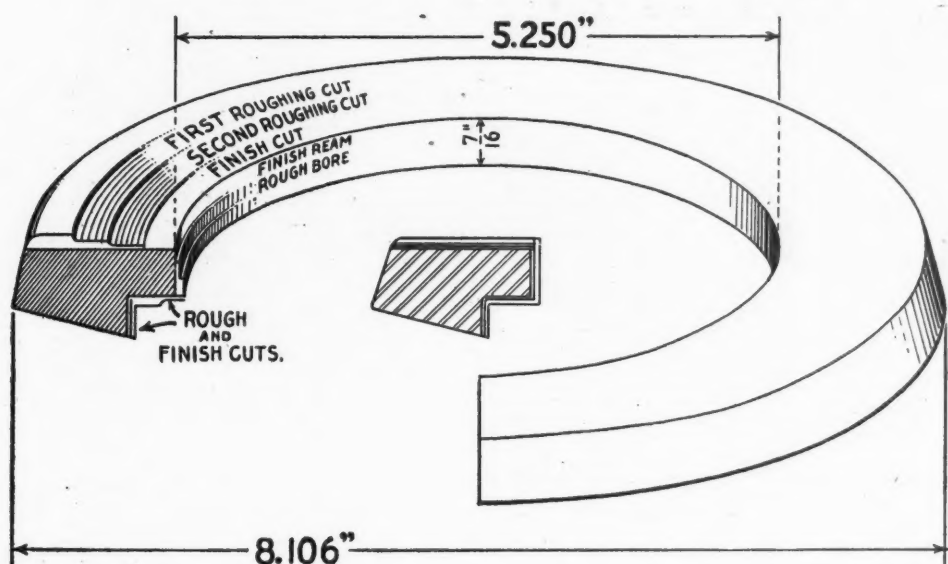
If you would drill most economically do it the NATCO way. More details on request.

THE NATIONAL AUTOMATIC TOOL CO.

RICHMOND, INDIANA, U. S. A.

FOREIGN AGENTS: For British Isles: Burton Griffiths & Co., Ludgate Square, Ludgate Hill, London. For France: Aux Forges De Vulcain, Paris. For Germany: Heinrich Dreyer, Berlin.

CHROME-VANADIUM RING GEAR

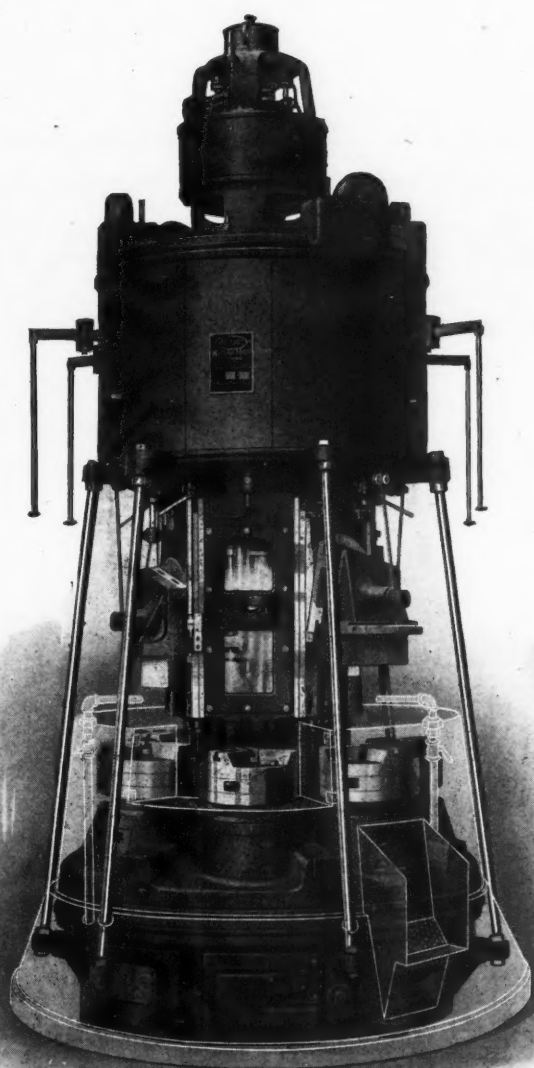


585 Every
Eight Hour
Shift

680,
High Run, in
Eight Hours

is a fine
example of

Intensive
Production



BULLARD

MULT-AU-MATIC Vertical Lathes

*Are making and main-
taining* similar pro-
ductive records in a
number of well-known
plants.

Your work can be
produced faster and
cheaper.

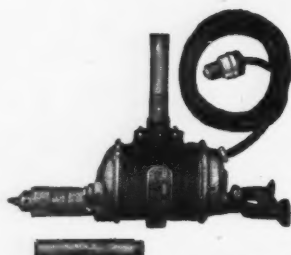
Let us show you how.

**THE BULLARD MACHINE
TOOL COMPANY**

Bridgeport, Connecticut
U. S. A.

IT'S UP TO YOU

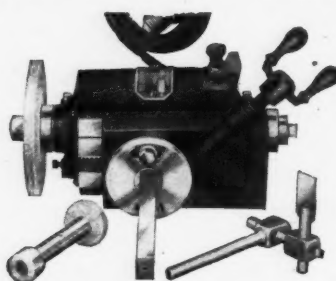
To increase your Production and Reduce your Costs
by installing "CINCINNATI" Portable Electrics
TRY THIS TRIO



HAND OR BREAST DRILLS
1/4", 3/8", 1/2", 3/4" capacities.
Weight from 7 pounds up. Gears
run in grease. Single and two
speeds.

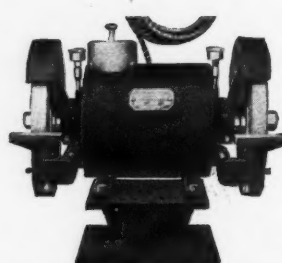
SCREW-FEED DRILLS
3/8" to 2" capacities.

SCOTCH RADIAL DRILLS
1/8" to 2 1/2" capacities.



TOOL POST GRINDERS

1/4 to 3 H. P. Weight from 16
pounds up. Free hand feed.
Bearings adjustable to wear.
Horizontal and vertical feeds.
Different types for all purposes.



BENCH GRINDER OR BUFFER

Five sizes, 1/4 to 3 H. P. Also
Pedestal Floor Grinder 1 to 3
H. P. Fully enclosed. Dirt- and
dust-proof. Ball bearings.

Special Features: *Air Cooled. Ball and Thrust Bearings.
All working parts hardened. Overload Allowance.
Guaranteed Mechanically and Electrically.*

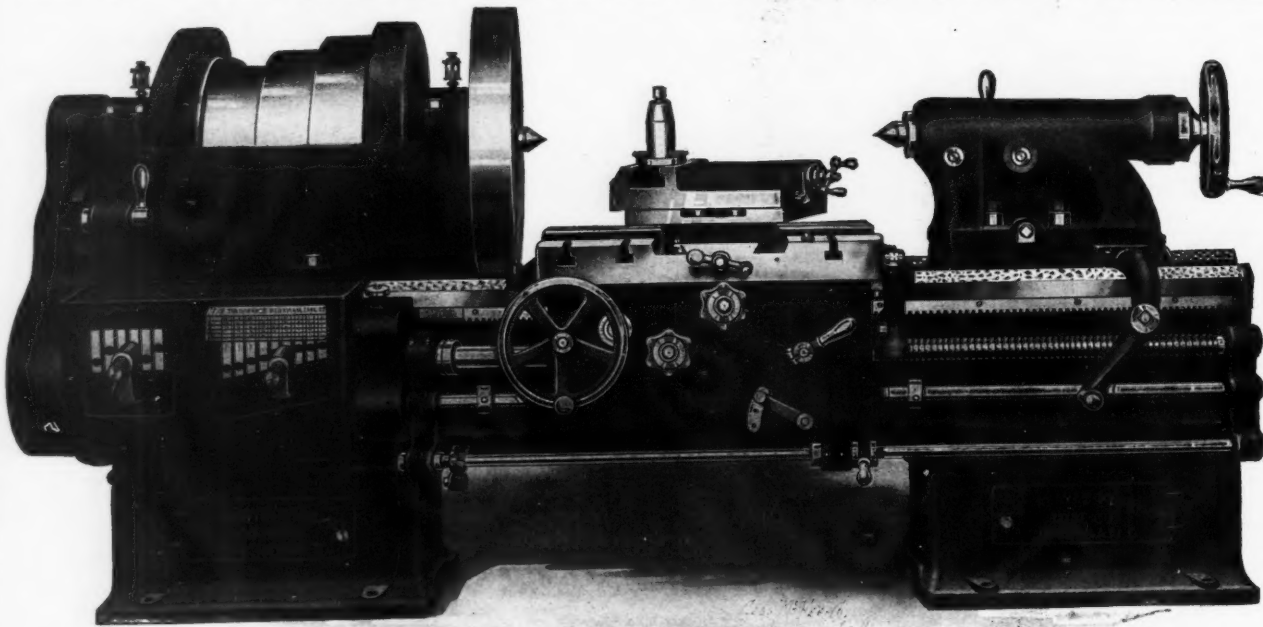
CINCINNATI ELECTRICAL TOOL CO.
650-652 Evans Street CINCINNATI, OHIO

FOREIGN AGENTS: England: S. Wolf & Co., London. Australia: Parke & Lacy Co., Ltd., Sydney. Norway: V. Lowener, Christiania. France:
R. S. Stokvis & Fils, Paris. Holland: R. S. Stokvis & Zonen, Ltd., Rotterdam. Japan: Yamatake & Co., Tokyo.

New York Office, 50 Church Street

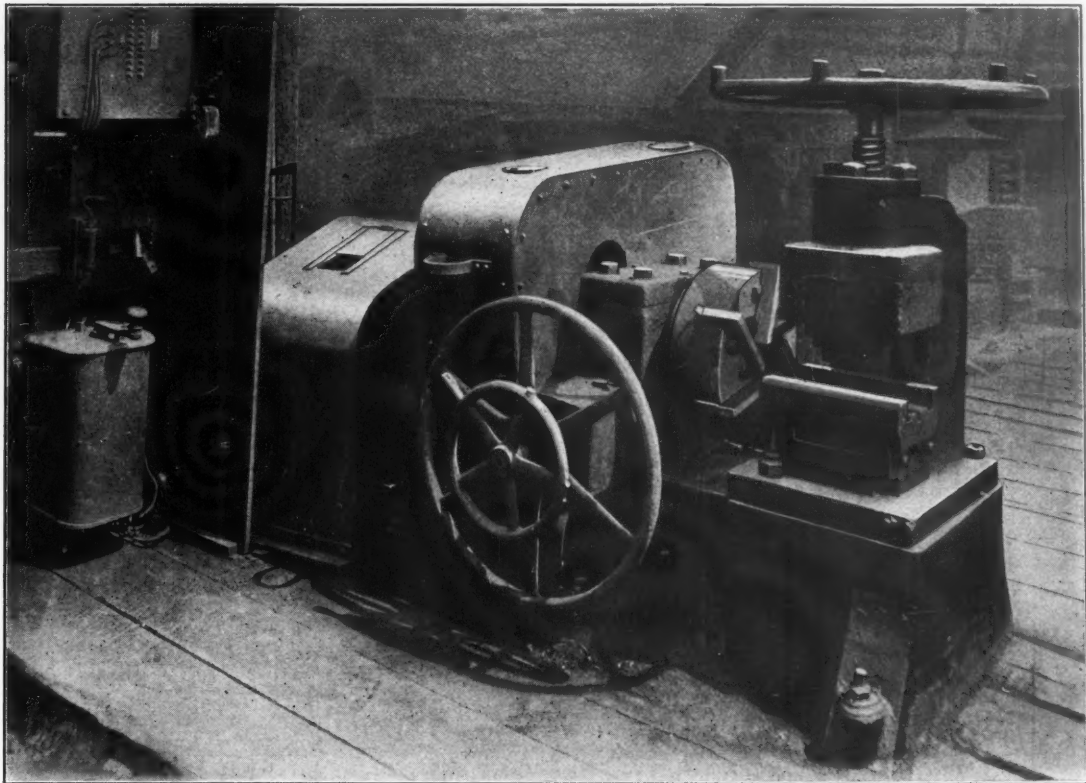
Stock and Service Department

G-K—MORE THAN JUST A LATHE



Most lathes are just lathes—nothing out of the ordinary, good enough for some purposes, most of them honestly built, but as like as peas in a pod. A G-K Lathe is different, different in important respects, in many details, in its very appearance. It is a better lathe—worth more because it can earn more—with an established company and years of experience behind it. Let us send the Booklet "G-K Betterments"—you'll find it worth studying.

THE GREAVES-KLUSMAN TOOL CO., Cincinnati, Ohio



NEWTON

An Old Rail Ending Machine That is Still "On the Job"

Although this Newton is ten years old in service, it's far from being a back number. With a few alterations, made necessary by changing conditions, it meets requirements with efficiency characteristic of the latest models.

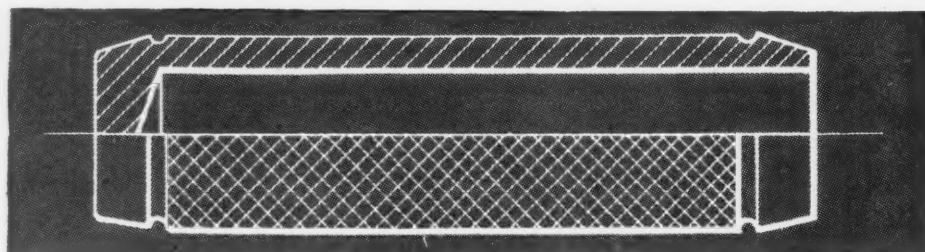
The design of Newton Rail Ending Machines is practical, being governed primarily by the specific practice they're expected to undergo. As a result every Newton is a square peg in a square hole and covers its particular field as no other similar machine can.

Every Newton is equipped with the very latest means for convenience and quick handling of stock; they're really ahead of ordinary practice as a matter of fact; and it's that very feature in a Newton that guarantees adaptability to meet any and all conditions satisfactorily.

The Newton line of frog, switch and rail rolling mill tools is complete; every machine characterized by power, speed and reliability to insure service of the highest order.

Send for catalog for all the details.

NEWTON MACHINE TOOL WORKS, Inc.,
23rd and Vine Streets **PHILADELPHIA, U. S. A.**



One Every Two Minutes on the CLEVELAND AUTOMATIC

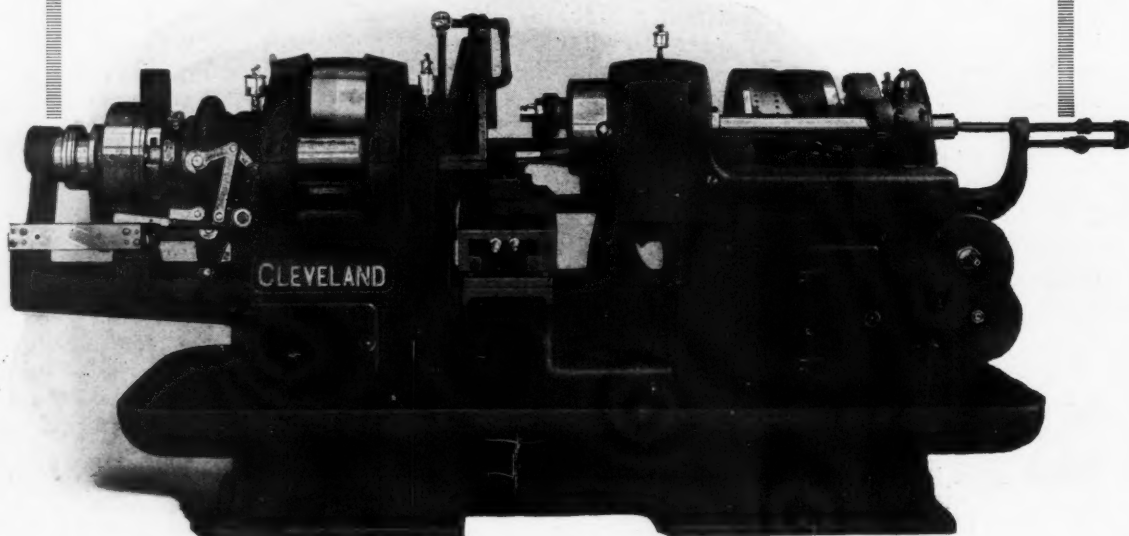
Consider the size and nature of this job, and the depth of the hole—then the 32 per hour rate at which the 1¼" Model A Cleveland Automatic turns it out will give you an idea of what the machine can do for you. The piece shown above is knurled its entire length and tapered at both ends.

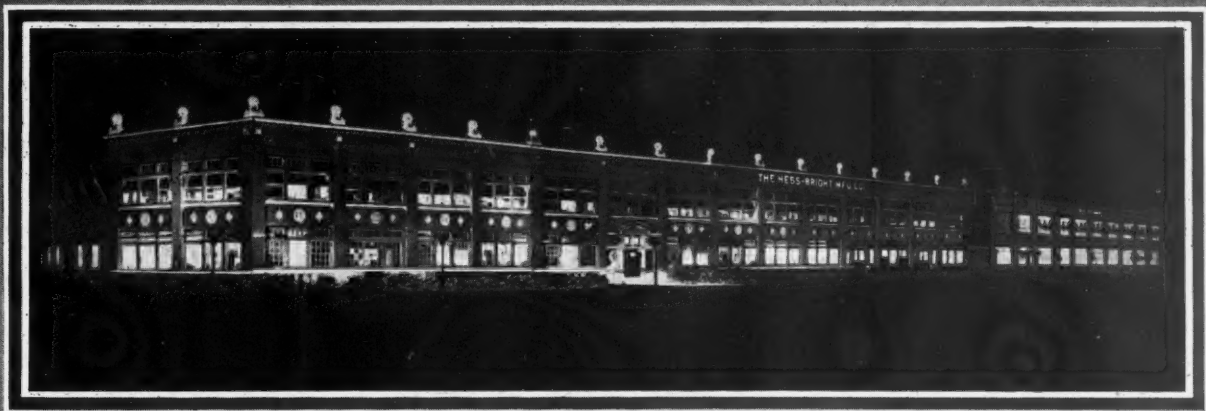
The tooling necessary on this job is as follows: Gauge stock to length; center for drill; drill half way and knurl full length; drill hole to full depth and form; cut off.

Fine finish, speed and accuracy with low labor cost are clearly defined advantages of Cleveland Automatic production. Let us give you conclusive proof.

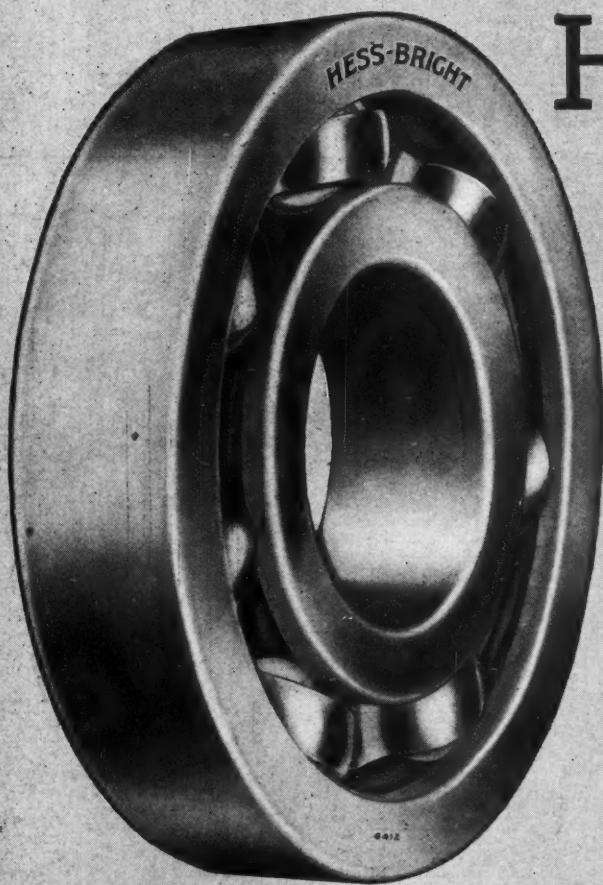
Cleveland Automatic Machine Co.
CLEVELAND, OHIO, U. S. A.

EASTERN REPRESENTATIVE: J. B. Anderson, 211 Gowan Ave., Mt. Airy, Philadelphia. WESTERN REPRESENTATIVE: Herbert E. Nunn, 565 West Washington St., Chicago. FOREIGN REPRESENTATIVES: Chas. Churchill & Co., Ltd., London, Manchester, Birmingham, Newcastle-on-Tyne and Glasgow.





HESS-BRIGHT BALL BEARINGS



HAVE turned millions of revolutions on thousands of machines of hundreds of types for scores of purposes, standing millions of pounds of radial and thrust pressure.

They have done this in all climes, under varying conditions, with and without proper care, properly and improperly mounted or applied—and *they have stood up under it all.*

Thus they are carrying industry's burdens to the greater benefit of mankind.

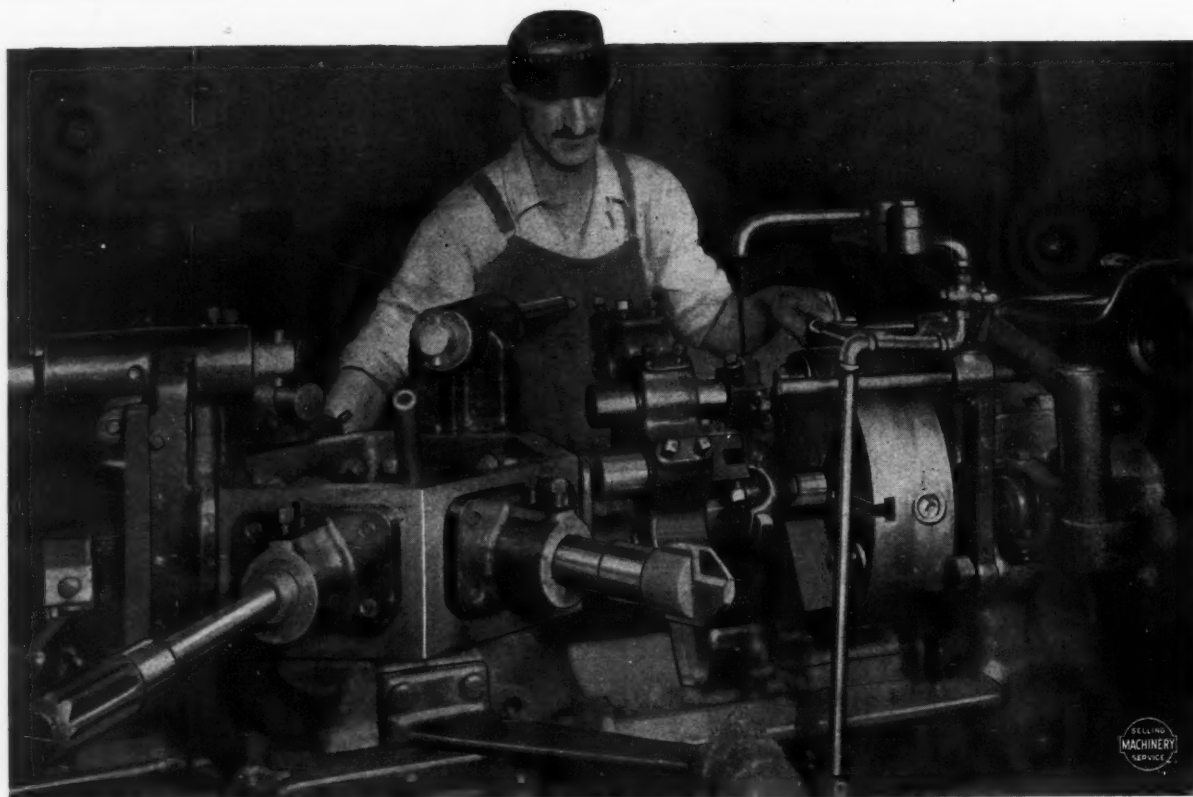
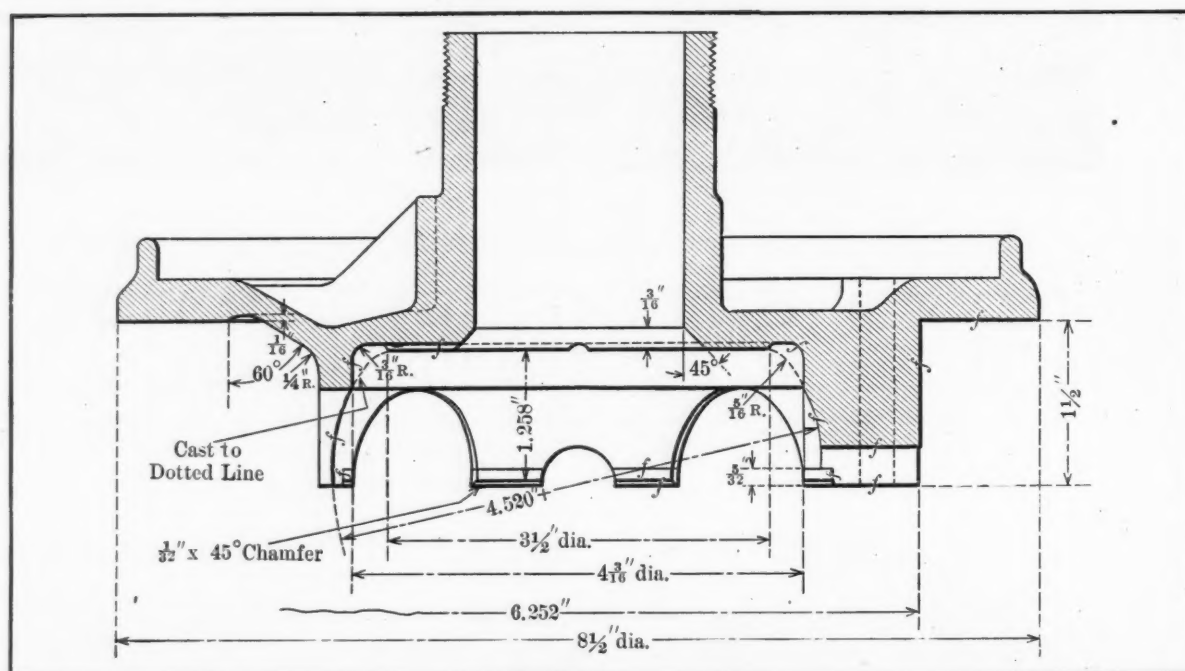
Such is their reward. Their virtues have been proved. They have stood the test of time's worst task-master—Service.

Select the right Hess-Bright for *your* need and *your* bearing problems are solved. Let our engineers aid you in the solution of your problems.

HESS-BRIGHT'S CONRAD PATENTS
ARE THOROUGHLY ADJUDICATED

HESS-BRIGHT MANUFACTURING COMPANY
FRONT STREET AND ERIE AVENUE PHILADELPHIA, PA.

Again: Big Production from



THE WARNER & SWASEY

New York Office—Singer Bldg.
Detroit Office—Ford Bldg.

Boston Office—Oliver Bldg.
Chicago Office and Show Rooms—618-622 Washington Blvd.

Buffalo Office—Iroquois Bldg.

Two Cuts at One Time on the Universal Hollow-Hexagon Turret Lathe

Because the Anderson Electric Car Company of Detroit machines its differential cases on the Universal Hollow-Hexagon Turret Lathe it is able to reduce operations at the first setting, normally seven, to five. Consequently a ten hour day's production at the first setting is fifty cases. The Anderson people consider this most excellent performance.

The material is malleable iron. The operations at the first setting are as follows:

First, chamfer 45 degrees. Second, rough bore, face inside race with turret, and *at the same time* face the 8 1-2 inch diameter flange with the carriage. Third, rough turn radius. Fourth, finish bore, and *at the same time* finish face gear bearing, finish flange, and finish radius surface. Fifth, ream.

This ability to take two cuts at one time is furnished by means of independent feed shafts for carriage and turret saddle. Each has ten individual feeds in either direction. While boring or turning with the hexagon turret the carriage will face, undercut or form.

Among the other good features of the Universal Hollow-Hexagon Turret Lathes are the power rapid traverse, great reserve power, and the rigidity that assures accuracy.

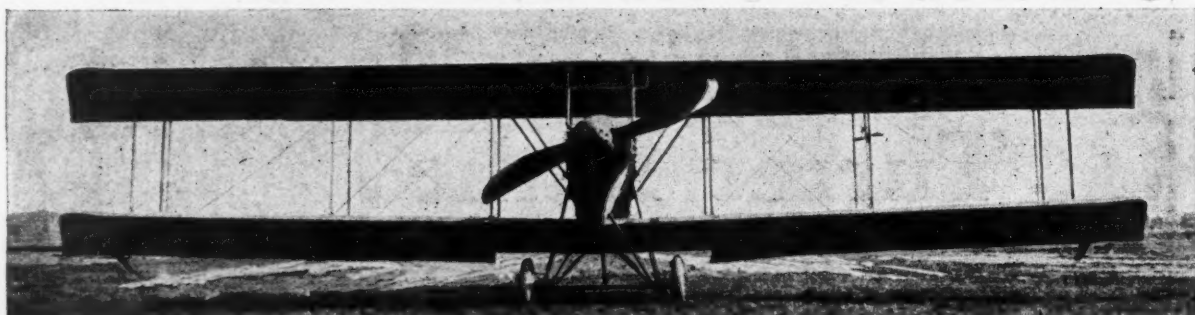
Send blueprints of one of your exacting jobs for a reliable estimate of the time saving effected by these machines

COMPANY, Cleveland, Ohio

FOREIGN AGENTS: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. Allied Machinery Company, Paris and Turin. Van Rietschoten & Houwens, Rotterdam. Yamatake & Co., Tokio. Benson Brothers, Sydney and Melbourne. A. Asher Smith, Sydney. A. R. Williams Machinery Co., Ltd., Toronto, St. John, Winnipeg and Vancouver. Williams & Wilson, Ltd., Montreal.

THE TILTED TURRET

A CLEAR TRACK FOR THE STOCK



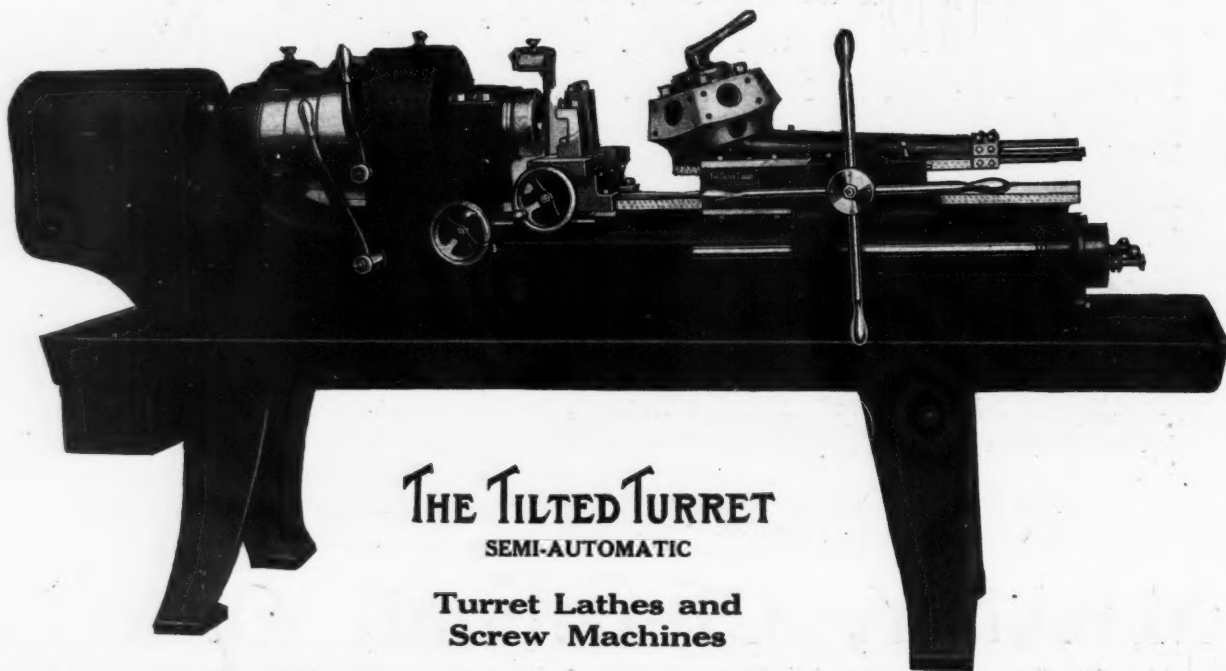
WHERE ACCURACY and DEPENDABILITY Are Vital Factors of Construction

ACCURACY is one of the most important and prime features of construction in airplane work. Mechanical parts are subject to the most rigid and minute inspection.

It is in this class of work THE TILTED TURRET excels. No matter whether your operations be on bar stock or chuck work, where duplicate parts are essential, you will find THE TILTED TURRET a superior machine tool. At the present time, a large portion of the entire production of THE TILTED TURRET is being purchased by airplane manufacturers, which proves its DEPENDABILITY. THE TILTED TURRET is fifteen years old and the duplicate orders prove its efficiency. Ask the user.

Do These Facts Interest You As a User or Prospective Purchaser of Turret Machinery?

Our Catalog M-19 describes methods of construction of THE TILTED TURRET as well as showing the various sizes and models we manufacture. Your copy awaits you.

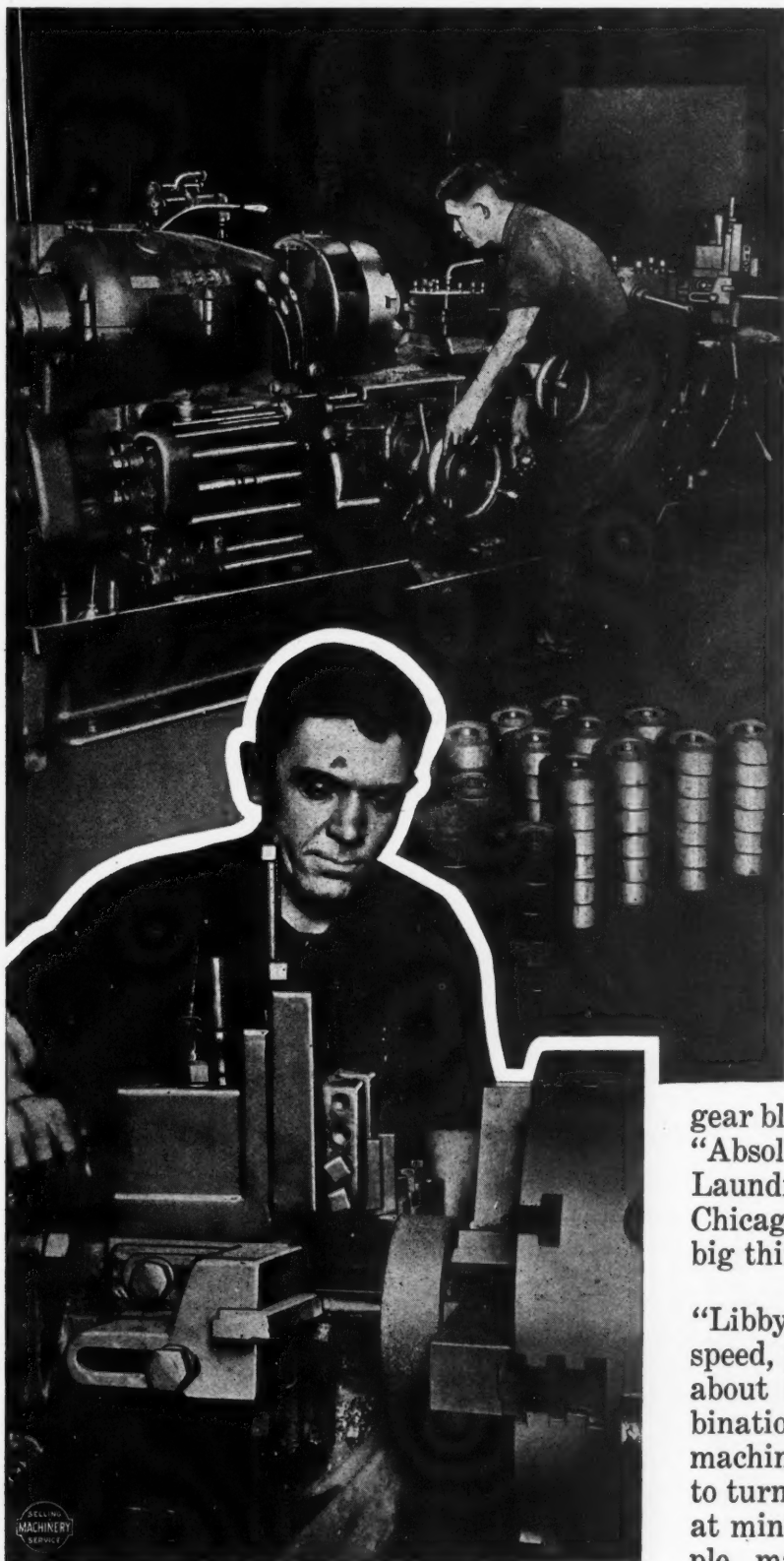


THE TILTED TURRET
SEMI-AUTOMATIC

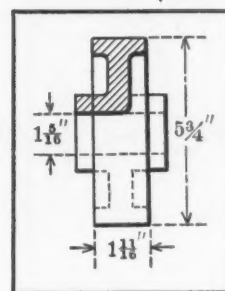
**Turret Lathes and
Screw Machines**

WOOD TURRET MACHINE CO.

BRAZIL INDIANA U.S.A.



Absolutely O.K.



"Leave it to Libby"

The work is gear blanks 5 3/4" diameter, 1 11/16" face, 1 5/16" bore; 3/16" stock is removed, two cuts are taken, two settings finish the job. Close accuracy and fine finish are observed, yet the Libby Lathe turns out a gear blank complete in 12 minutes. "Absolutely O. K.," says the Troy Laundry Machinery Co., Ltd., Chicago, Ill.—and they demand big things of their machines.

"Libby" users consider "Libby" speed, power, accuracy and range about the finest production combination on the market. These machines are designed and built to turn out the maximum of work at minimum cost. They are simple machines to operate, have power for heavy cuts, can be driven hard and are economical on all work they handle.

*If you've an unsolved production problem
"Leave it to Libby." We shall be glad to
show how a Libby Lathe will take care of it.*

INTERNATIONAL MACHINE TOOL CO.

INDIANAPOLIS, INDIANA, U. S. A.

DOMESTIC AGENTS: Bowman-Blackman Machine Tool Co., St. Louis, Mo. Brown & Zortman Machinery Co., Pittsburgh, Pa. Eccles & Smith Co., San Francisco, Cal.; Los Angeles, Cal.; Portland, Ore. E. L. Easley Machinery Co., Chicago, Ill., and Milwaukee, Wis. Strong, Carlisle & Hammond Co., Detroit, Mich., and Cleveland, Ohio. Vandek-Churchill Co., New York, N. Y.; New Haven, Conn., and Philadelphia, Pa. Syracuse Supply Co., Syracuse, N. Y., and Buffalo, N. Y. FOREIGN AGENTS: Coats Machine Tool Co., Ltd., London, Eng. Ugo Violini & Co., Milan, Italy. Iznoskoff & Co., Petrograd, Moscow and Ekaterinburg, Russia.

GURNEY

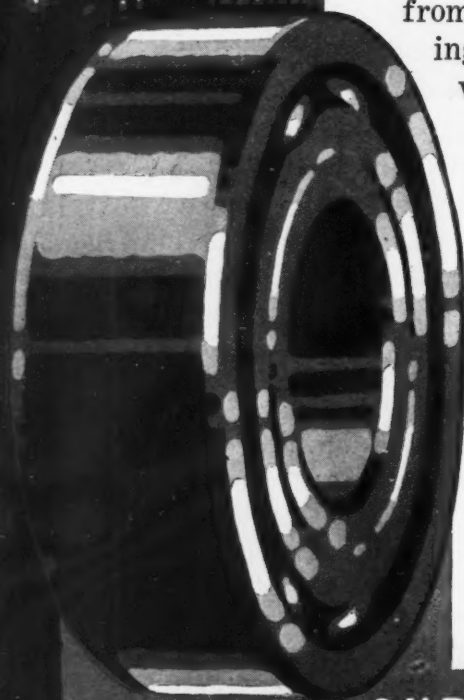
Watching for Hot Bearings is non-productive work

FOR MAXIMUM EFFICIENCY the operator of any kind of machine should be able to devote his entire attention to the turning out of work. Anything which distracts attention from the productive work, such as frequent oiling, or watching a cranky bearing to see whether it is getting hot, reduces efficiency.

When Gurney Ball Bearings are used, the increased mechanical efficiency is only a small part of the total saving. The greater saving is in the trouble-proof operation of the bearings—no frequent oiling, no watching for hot bearings, no adjustments for worn bearings, no shut-downs to replace bearings.

The big advantage of Gurney Bearings is that you can forget them once they are installed.

117

**GURNEY BALL BEARING CO.**

CHICAGO

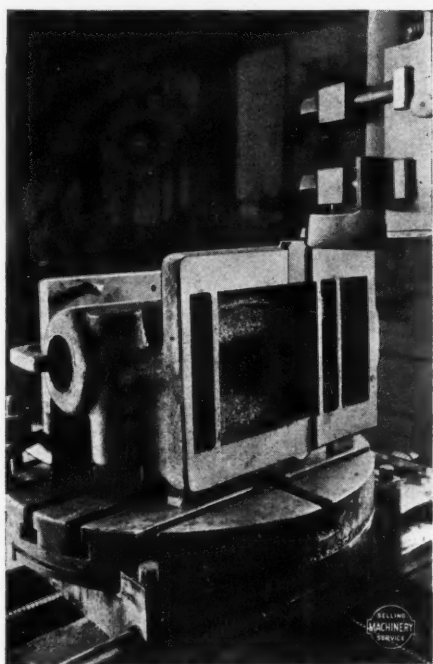
Conrad Patent Licensee
JAMESTOWN, NEW YORK

NEW YORK CITY

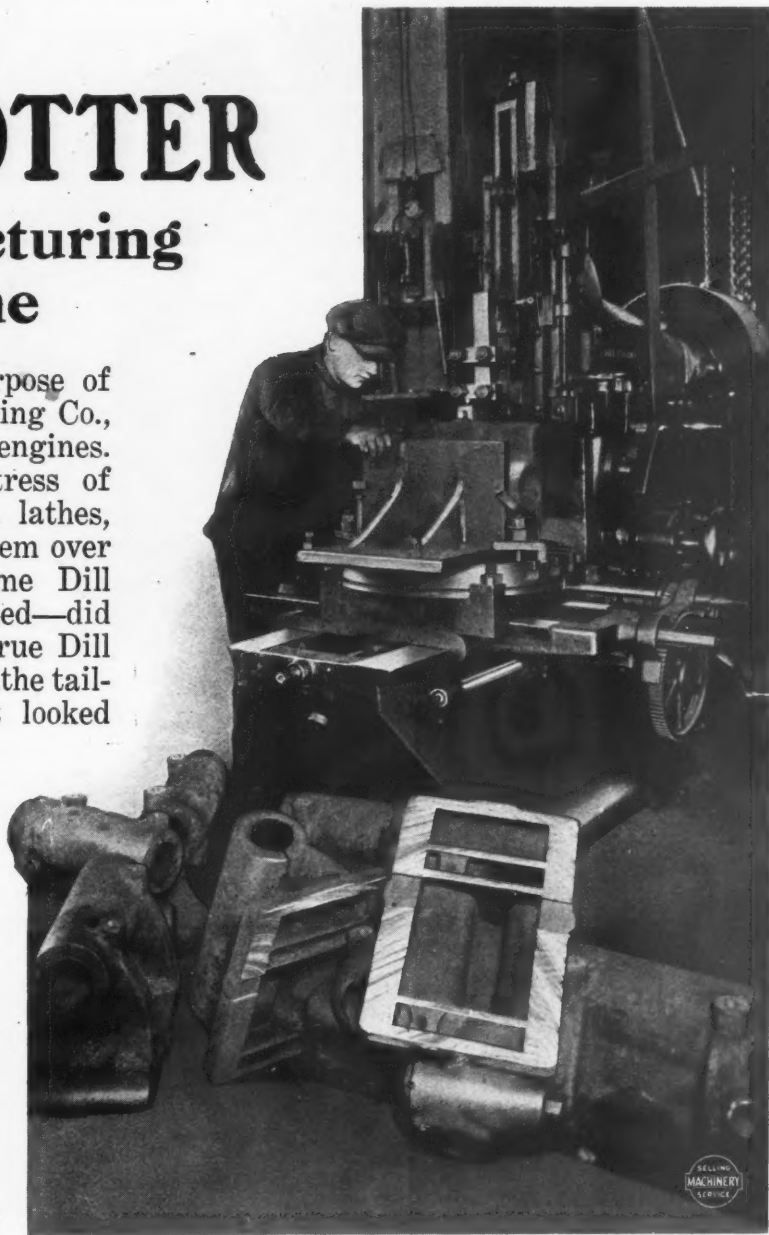
The DILL SLOTTER

is a Manufacturing Machine

It was purchased for the purpose of helping the Shepherd Engineering Co., Williamsport, Pa., to build engines. When this concern, under stress of necessity, began turning out lathes, the machine that helped tide them over the hard spots was this same Dill Slotter. It planed, shaped, milled—did everything put up to it with true Dill efficiency. The bottoms of 20" lathe tail-stocks—a machining job that looked like a sticker because no machine could be spared for the work—is just one of the jobs on which the Dill made a record.



Photographs secured through the courtesy of the Shepherd Engineering Company, Williamsport, Pa.



A single iron fixture holds the work. When a tail-stock comes off, even a surface plate fails to show up a low spot; the slot has been run across the surface and in the tongue recess at the rate of 25 pieces per 25 hours, floor to floor.

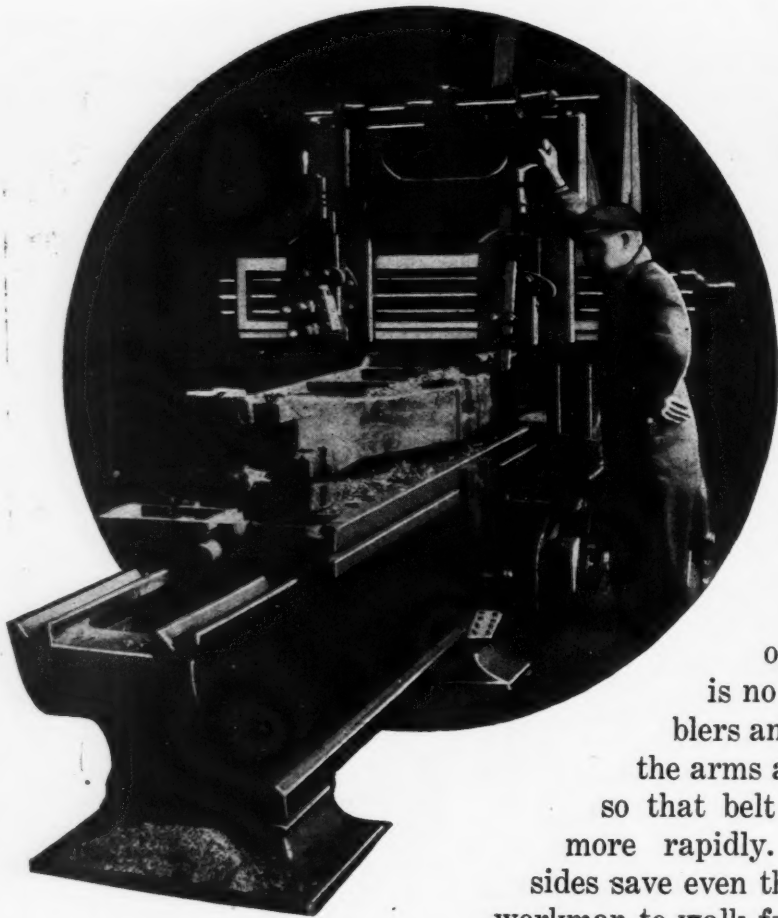
With a Dill Slotter handy you can do practically anything on any shape or size work. There are reasons—Dill rotating lathe, traveling head and a few others.

Write for the whole story.

T. C. Dill Machine Company

The Dill Slotter People, Philadelphia, Pa.

FOREIGN AGENTS: Coventry, London, Birmingham, Leeds, Manchester, Newcastle-on-Tyne and Glasgow, Alfred Herbert, Ltd. France: Alfred Herbert, Ltd. Italy: Alfred Herbert, Ltd. Japan: Alfred Herbert, Ltd. Yokohama. Germany and Austria: Heinrich Dreyer, Berlin, Germany. Holland: R. S. Stokvis & Zonen, Ltd., Rotterdam. Belgium: R. S. Stokvis & Fils, S.A., Brussels.



The "OHIO" Planer Has Table Dogs and Shifter Levers on Both Sides

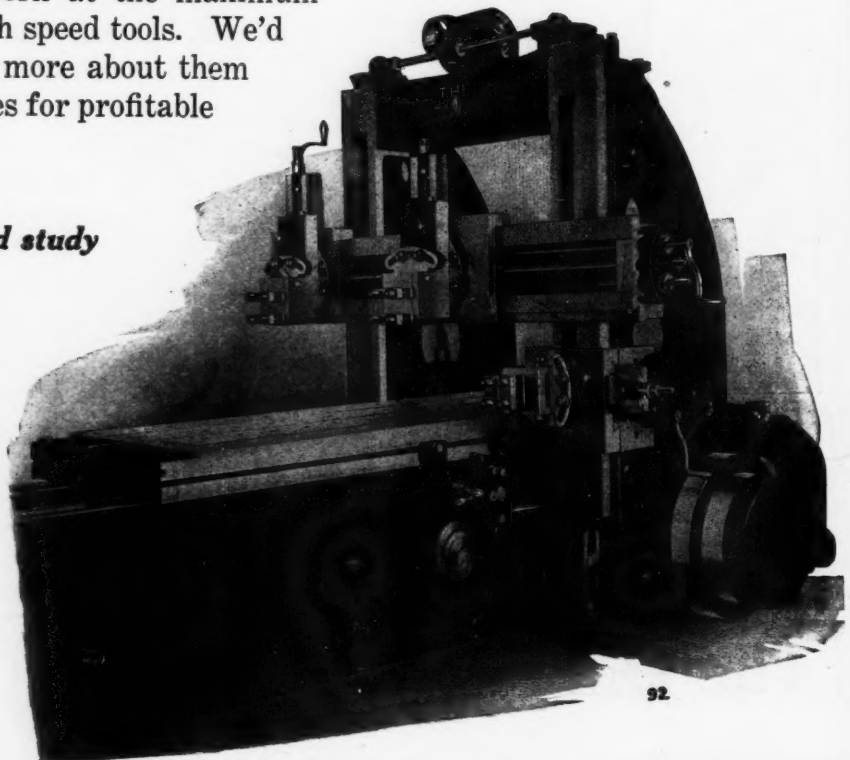
This feature is right in line with the high production principle so thoroughly developed in "Ohio" Planers. There is no lost motion between the tumblers and the belt shifter arms, and the arms are located close to pulley so that belt can be shifted much more rapidly. Levers on both sides save even the time it takes a workman to walk from one side to the other.

The "Ohio" represents the latest design in metal planing machines, and is built throughout for accurately machining the heaviest classes of work at the maximum capacity of high speed tools. We'd like you to know more about them and their possibilities for profitable service in your plant.

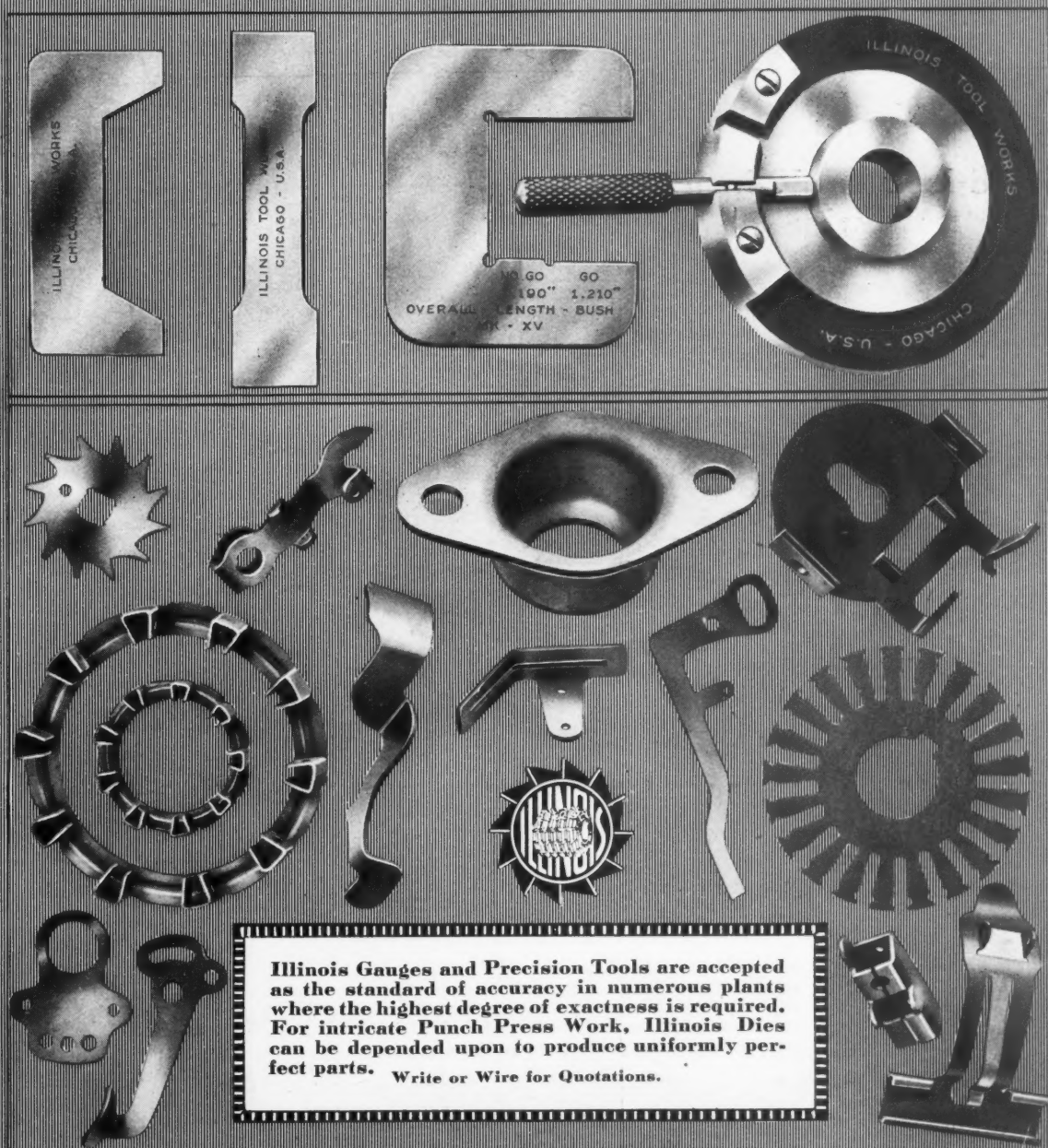
Send for the catalogue and study their many fine points.

**OHIO MACHINE
TOOL COMPANY**
KENTON OHIO

Planers and Shapers
Since 1887



ILLINOIS GAUGES & DIES



ILLINOIS TOOL WORKS, CHICAGO, U.S.A.
Manufacturers and Designers of Cutters—Hobs—Reamers



Complete Line

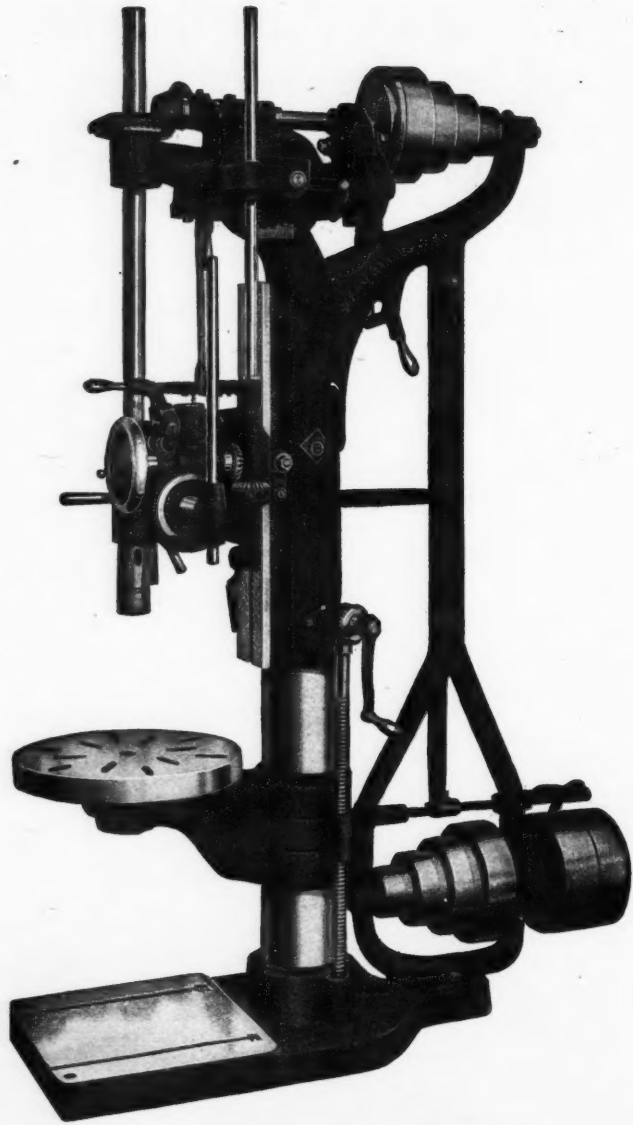
**8-inch to 50-inch
Swing**

**(With or without
Tapping
Attachment)**

**Upright
Drills**

**Horizontal
Drills**

**Gang
Drills**



BARNES DRILLS

**Accuracy
Convenience of Operation
Strength**

**MADE BY
W. F. & John Barnes
Company** 231 Ruby Street
Rockford, Ill., U. S. A.

When East and West Agree

This punch—

Made by Mehl Machine Tool & Die Co., Roselle, N. J.—

For Western Electric Co., Hawthorne, Ill

Allowed limit of error $\pm .0001''$.

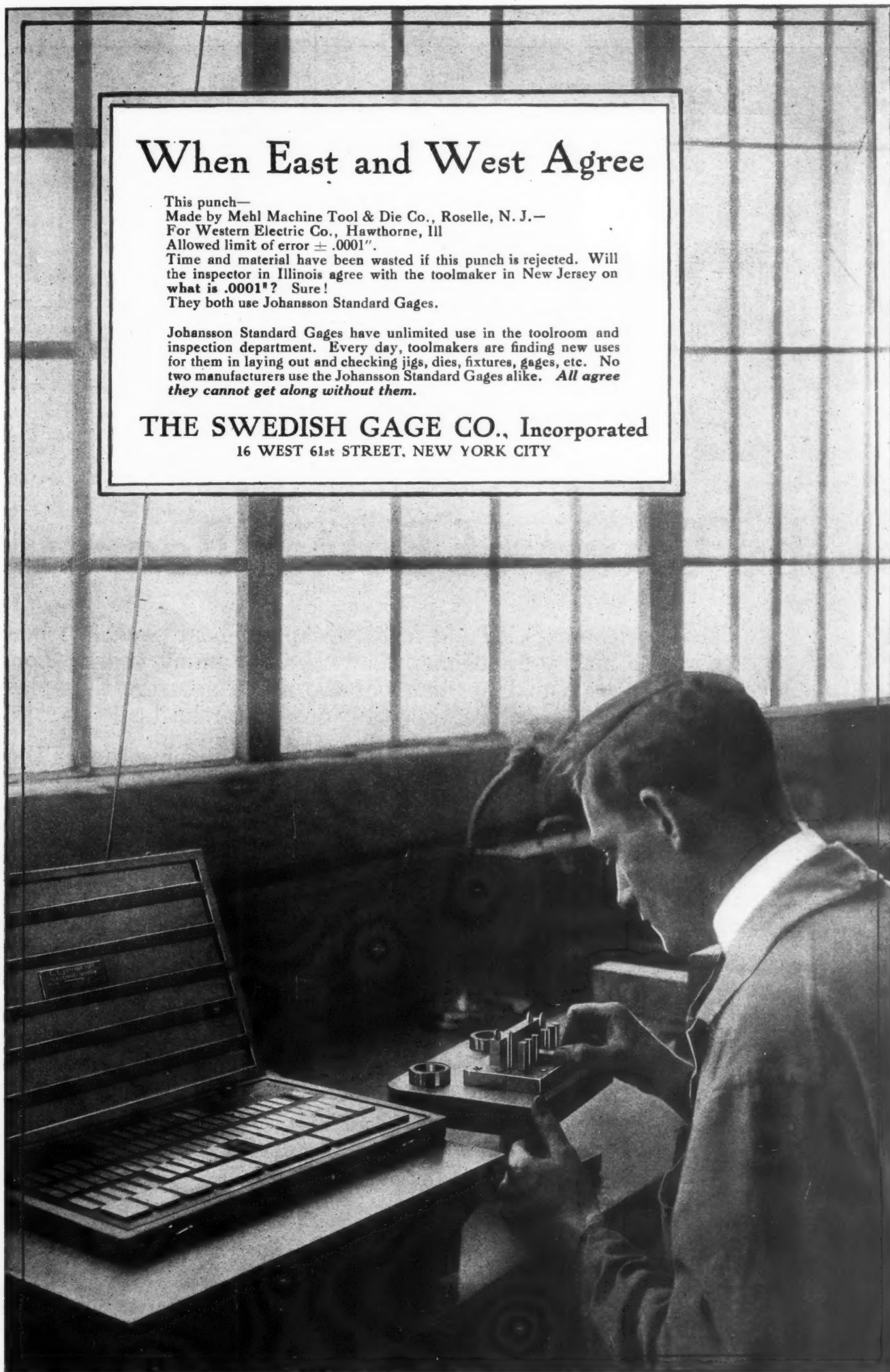
Time and material have been wasted if this punch is rejected. Will the inspector in Illinois agree with the toolmaker in New Jersey on **what is .0001''?** Sure!

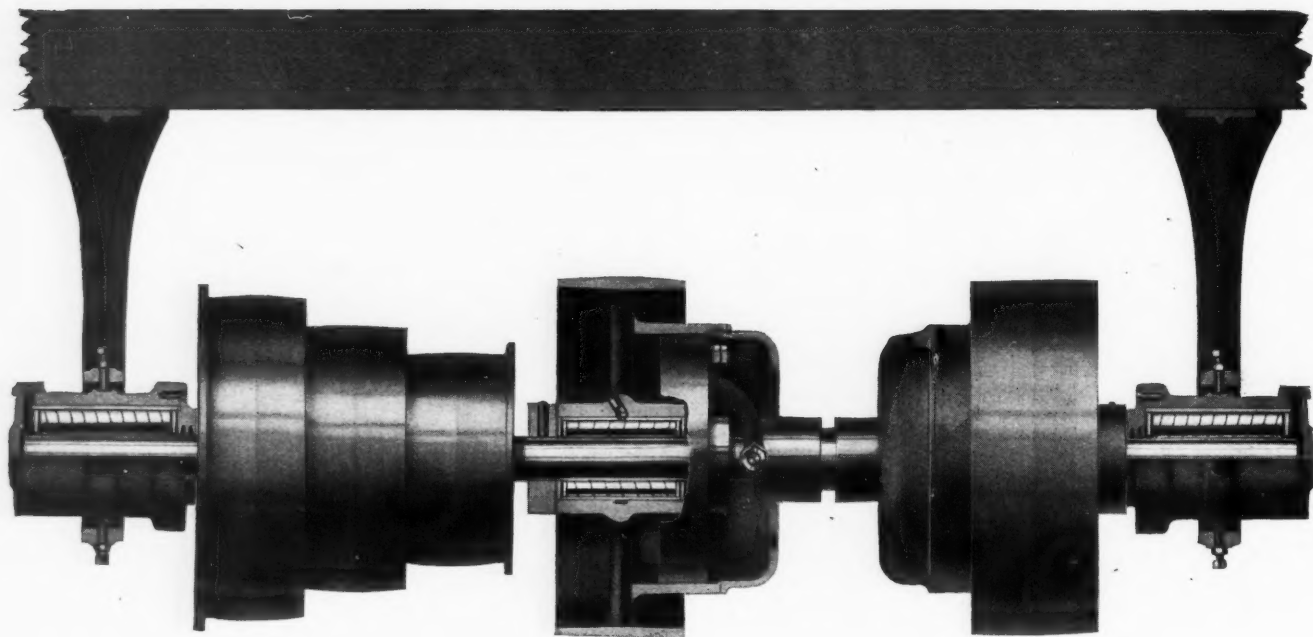
They both use Johansson Standard Gages.

Johansson Standard Gages have unlimited use in the toolroom and inspection department. Every day, toolmakers are finding new uses for them in laying out and checking jigs, dies, fixtures, gages, etc. No two manufacturers use the Johansson Standard Gages alike. *All agree they cannot get along without them.*

THE SWEDISH GAGE CO., Incorporated

16 WEST 61st STREET, NEW YORK CITY





In the Cause of Better Bearings;

The shortcomings of old-fashioned plain bearings have been known to machine tool manufacturers for many years. Long ago it was decided by many of the manufacturers that plain bearings were a failure, especially on countershafts.

In theory plain bearings may be all right. But in practice they fall down hard.

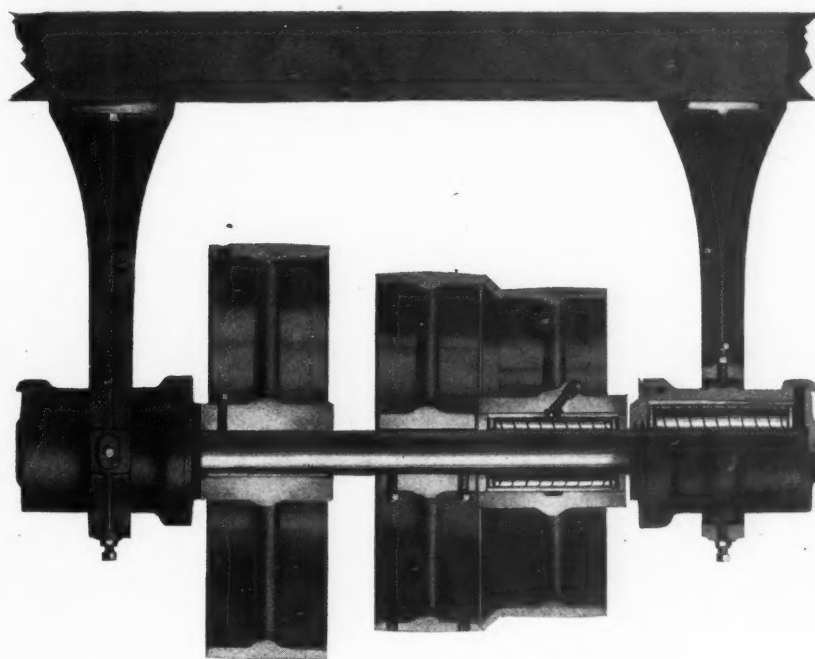
Bad lubrication is chiefly responsible for their miserable failure. They won't hold the lubricant at all. The oil leaks out; the bearing runs dry. The machine must stop.

A machine tool operator must not be hampered by unreliable bearings. He must feel free to speed up his machine whenever conditions demand it. He must not live in fear of his bearings breaking down. For the sake of his efficiency, you should save him the worry of bearing trouble. Let him have confidence in his machine—put Hyatt Bearings on the countershaft.



Hyatt Roller Bearings are anti-friction. They save power.

HYATT BEARINGS



Greater Speeds, Constant Service

And Hyatt Roller Bearings solve lubricating troubles. Hyatt Rollers are hollow and have spiral slots. Each roller acts as a reservoir for oil. Through the spiral slots the oil is sent oozing out over the whole bearing surface and back into the roller again. The oil is always on the move and always doing good. Every drop of oil is used to such advantage that Hyatt Bearings don't need oiling more than once a month.

Greater speeds! Constant service! Long life! Ideal lubrication! That's what Hyatt Bearings should mean to you. Think the matter over.

PARTIAL LIST OF USERS

Cleveland Automatic Machine Tool Co.,
Cleveland, Ohio
Hardinge Brothers,
Chicago, Ill.
Bullard Machine Tool Co.,
Bridgeport, Conn.
Chard Lathe Co.,
New Castle, Ind.
Foote-Burt Co.,
Cleveland, Ohio
National Automatic Tool Co.,
Richmond, Ind.
Bausch Machine Tool Co.,
Springfield, Mass.
Rockford Drilling Machine Co.,
Rockford, Ill.

Fox Machine Company,
Grand Rapids, Mich.
Ingersoll Milling Machine Co.,
Rockford, Ill.
Rockford Milling Machine Co.,
Rockford, Ill.
Landis Tool Co.,
Waynesboro, Pa.
Fitchburg Grinder Co.,
Fitchburg, Mass.
Barber-Coleman Co.,
Rockford, Ill.
Heald Machine Co.,
Worcester, Mass.
American Tool Wks.,
Cincinnati, Ohio

When you want data
on **HYATT BEARINGS**
for countershafts,
drop us a line.

HYATT ROLLER BEARING CO.
NEWARK NEW JERSEY

FOR COUNTERSHAFTS



And Solomon

Forgot to invite the Forgemaster to the banquet celebrating the completion of the temple.

When the throne was unveiled however there sat the forgemaster in the seat of honor the uninvited.

The guards rushed to cut him down; but Solomon said "How could this temple have been built but for this man?"

Now then, when building your engines, ships and machinery invite prices on

CAMDEN FORGINGS

We feel honored in receiving your invitation and shall strive to secure the place of honor by taking your order.

We are thoroughly equipped to make many forgings, light or heavy, for various industries and simply add what is below as a

"BUYERS GUIDE"

High and Low Carbon Bars
Press Columns and Rams
Water Cylinders
Pull Back Cylinders
Valve Bodies
Plungers
Weldless Steel Rings
Lathe Spindles, solid and hollow bored
Long Feed Screws
Power Press Crank Shafts
Cam Shafts

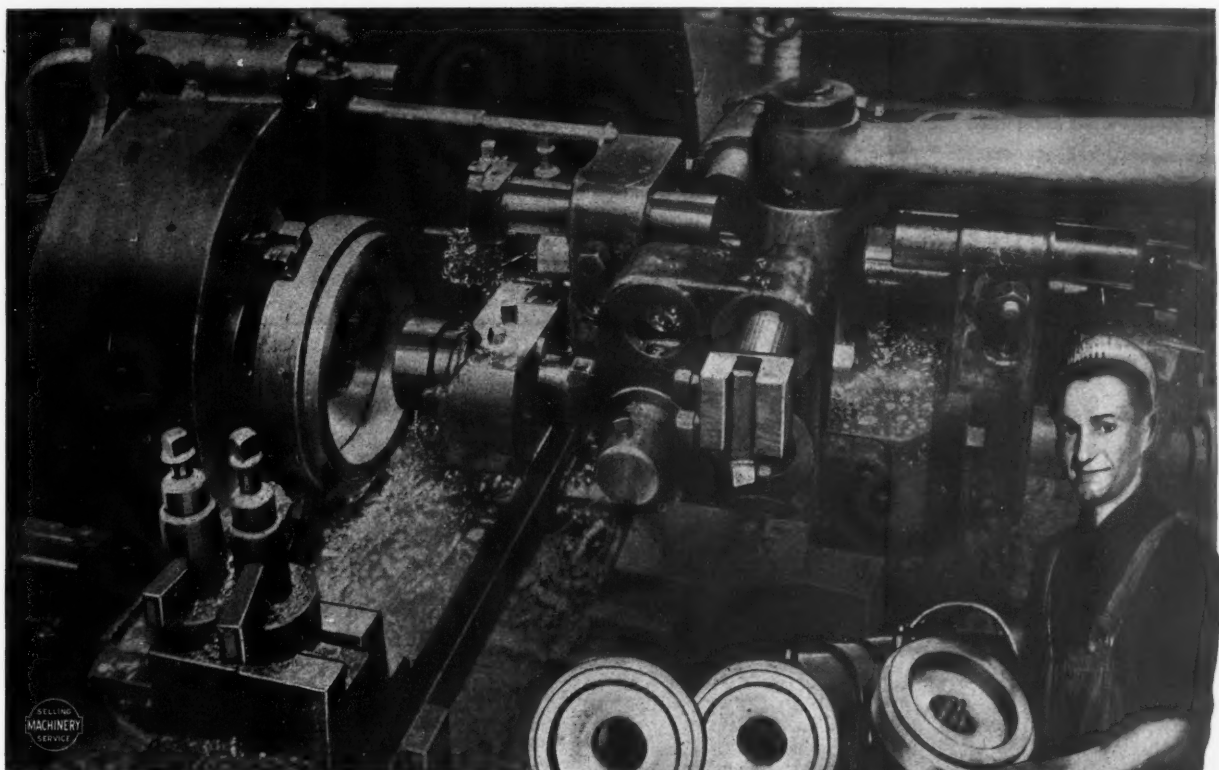
Eccentric Shafts
Crusher Shafts
Gear and Pinion Blanks
Side and Main Rods
Crank Pins
Axles
Locomotive Rod Straps
Guides
Parts of frame both in iron and steel
Hammered Iron Bars for locomotive
Repairs

Marine Shaft
Marine Connecting and Eccentric Rods
Bending
Feed
Rolls
Straightening
Embossing
Large Wrenches
Saw Arbors
Steam Engine Forgings
Pump Crank Shafts
Pump Connecting Rods

Large Nuts
Turbine Shafts
Mill Shafting
Trolley Car Axles
Electric Motor Axles

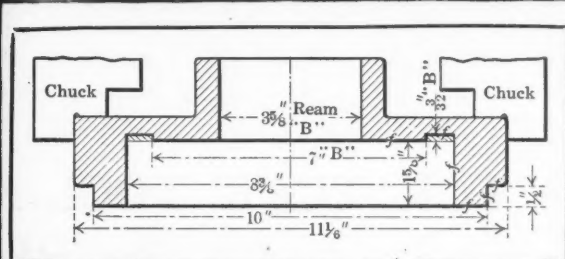
Any forging to your print and specifications, smooth forged, rough machined or finished complete in either iron or steel.

CAMDEN FORGE CO.
Mt. Ephraim Ave., CAMDEN, N.J.



A Lesson in Good Tooling

The work is a special drop forged gear blank, to be machined on the second setting. Operations include roughing and finishing the large recess in the center, finishing the outside face and cutting a recess on the outside diameter, as indicated by the sketch. The photograph shows the Potter & Johnston Automatic Chucking Machine tooled for the job, utilizing the four turret positions and the front and rear cross-slide positions, a working combination that makes this accurate bit of turning an exceedingly rapid performance.



Potter & Johnston — The Manufacturing Automatic

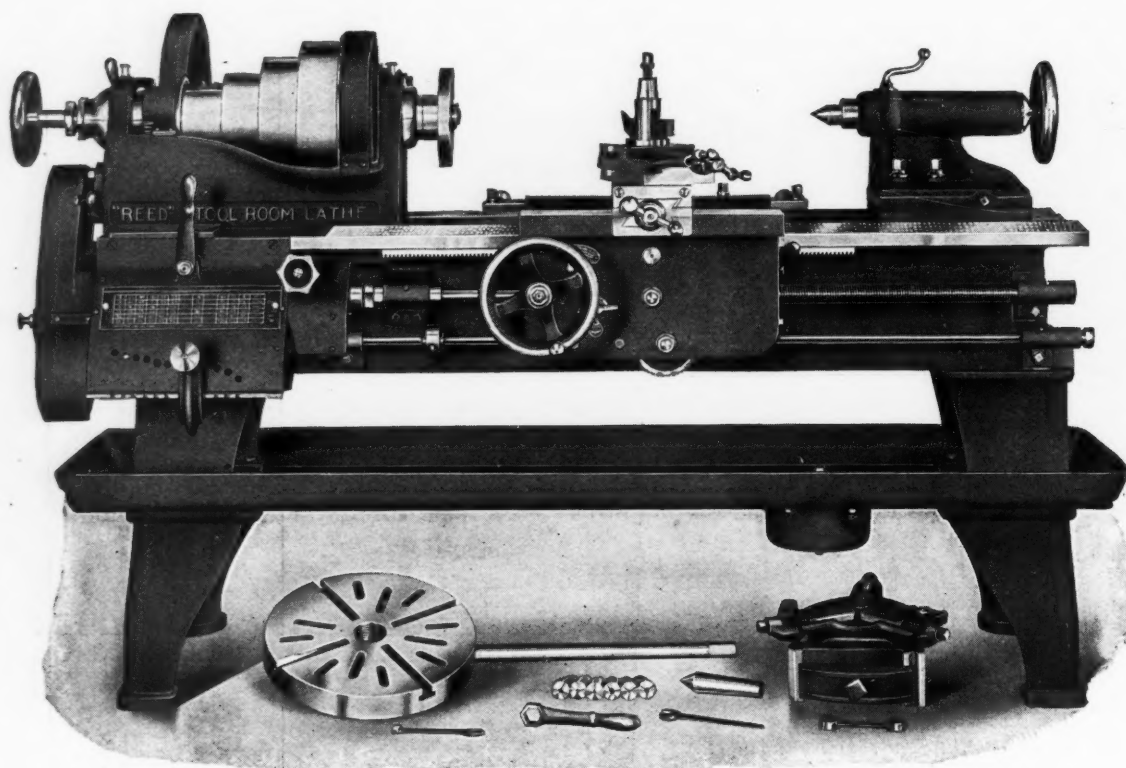
This machine can be tooled to handle work entirely outside the range of other lathes. All operations are automatic, one operator runs several machines; design is simple; machines are rapid, strong, durable and can be relied upon to lower costs. If the high cost of turning good work fast is one of your problems, write us.

POTTER & JOHNSTON, Pawtucket, R. I., U.S.A.

OFFICES AND REPRESENTATIVES: Office for Great Britain and France: 68 Avenue de la Grand Armee, Paris, J. Ryan, Manager. New York Office: Fulton Bldg., 50 Church St., Walter H. Foster Co., Managers. Detroit Office: Modern Machinery and Engineering Co., 1514 Ford Bldg. Chicago Office: 4213 Sheridan Road, Chas. H. Shaw, Manager. Toronto Office: 1501 Royal Bank Bldg., E. C. Roelofson, Manager. FOREIGN AGENTS: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester and Newcastle-on-Tyne, England, and Glasgow, Scotland. Ercole Vaghi, Corso Porta, Nuova 34, Milan, Italy.

REED-PRENTICE COMPANY

WORCESTER  MASS. U.S.A.



FOR YOUR TOOL-ROOM NEED GET A "REED"

BECAUSE

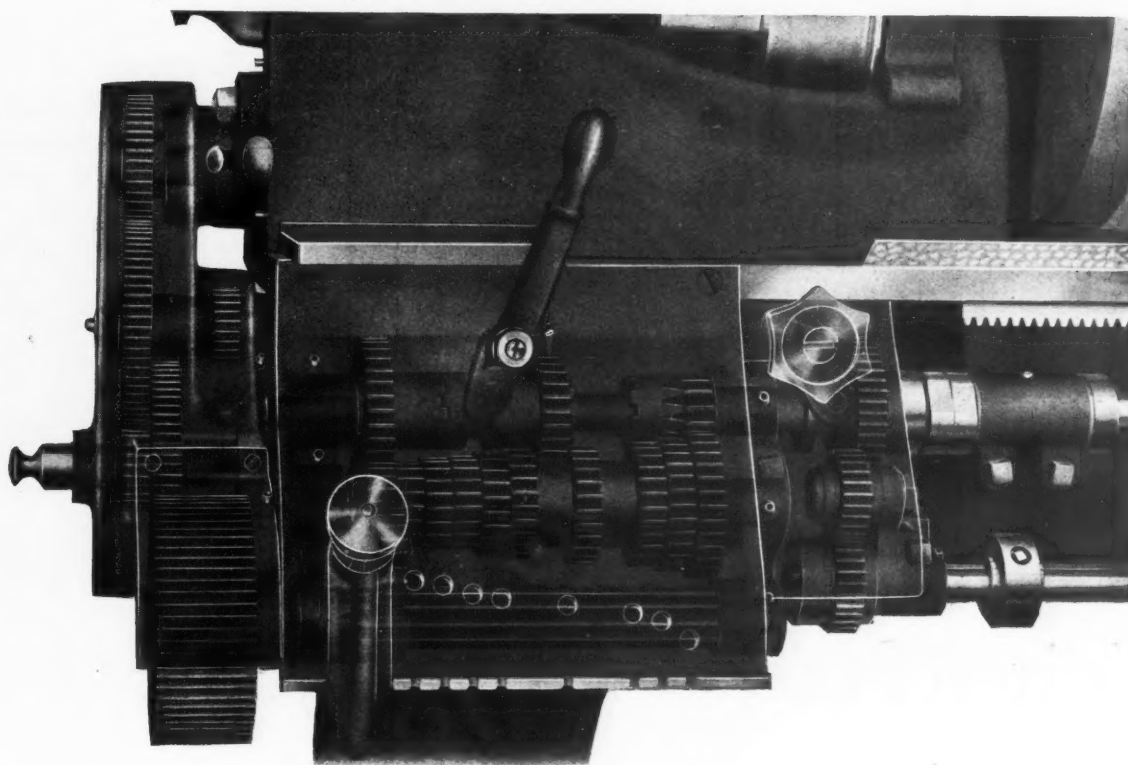
FROM FOUNDRY TO FINAL INSPECTION YOU CAN ALMOST SEE THE WORD "ACCURACY" PERSONIFIED IN EVERY ACT THAT TAKES PLACE IN THE MAKING OF THESE LATHES.

THAT WORD SO OFT REPEATED IS THE VERY SPIRIT OF ALL "REED" PRODUCTION, AND WHAT THEY ABSORB IN THEIR MAKING THEY GIVE OUT IN RESULTS.

YOU WILL FIND IN MOST TOOL ROOMS THAT THE CAREFUL JOBS GO TO THE BEST WORKMAN AND THE "REED" LATHE, FOR THE SAME REASON THAT A SURGEON DOES NOT USE A PEN-KNIFE WHEN BETTER TOOLS ARE AVAILABLE.

REED-PRENTICE COMPANY

WORCESTER  MASS. U.S.A.



THE "REED" QUICK-CHANGE GEAR SHOWN ABOVE

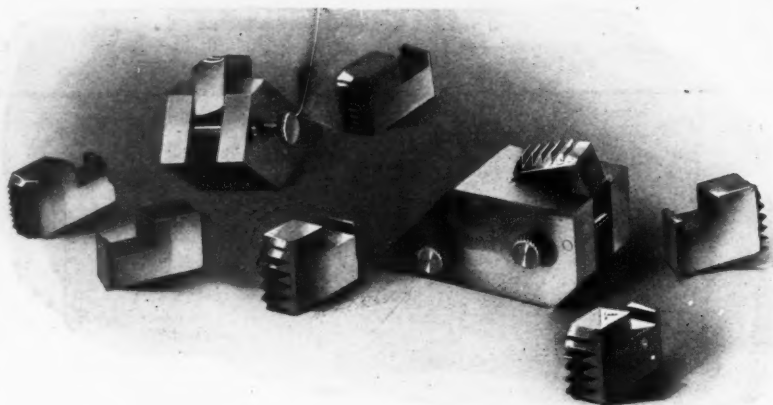
GIVES 60 CHANGES OF FEED AND 60 THREAD CUTTING VARIATIONS. THREADS FROM 2 TO 128 PER INCH ARE AT INSTANT COMMAND.

THE LEAD SCREW AND FEED ROD CANNOT BOTH ROTATE AT THE SAME TIME, AS CAN BE SEEN FROM THE X-RAY VIEW ABOVE.

YOU CAN EASILY SET TO THE CORRECT THREAD OR FEED BY READING THE MISTAKE-PROOF INDEX PLATE ATTACHED TO THE GEAR BOX. WHITWORTH-METRIC OR U. S. STANDARD LEAD SCREWS CAN BE SUPPLIED AS ORDERED.

MANNING, MAXWELL & MOORE, INC., NEW YORK
ALLIED MACHINERY CO. OF AMERICA, PARIS
FENWICK FRERES, PARIS

Chasers for Hartness Dies Are Easily Ground



These jigs are supplied gratis with new dies, and are sold separately at modest prices.

Full instructions for grinding chasers are sent with chasers.

A special grinder for this purpose is not required.

*These Jigs and
Any
Small Grinder
will Grind
Hartness Chasers
Quickly
and Correctly*

JONES & LAMSON MACHINE CO.

AUTOMATIC DIE DEPARTMENT

109 QUEEN VICTORIA ST. LONDON, ENG.
SPRINGFIELD VERMONT, U. S. A.

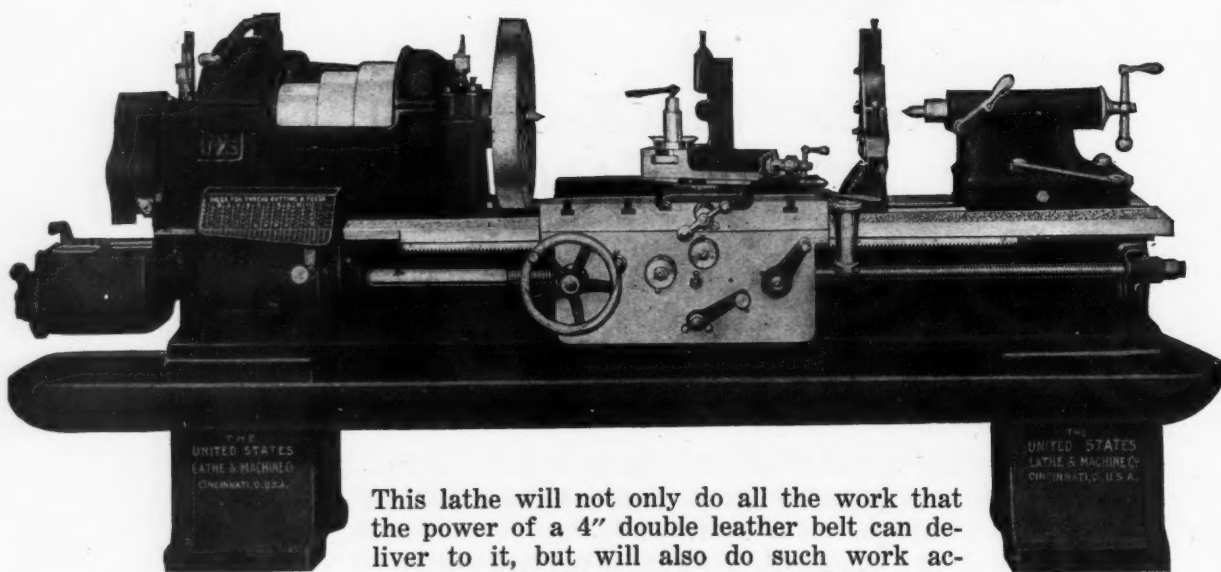
AMERICAN AGENTS FOR
DIES AND CHASERS

Barwood-Richards Mch. Co., Bourse Building,
Philadelphia.
Boyer-Campbell Co., Detroit.
Carey Mch. & Supply Co., Baltimore.
E. L. Esley Mch. Co., Chicago.
The E. A. Kinsey Co., Cincinnati and Indian-
apolis.
Machinists Supply Co., Pittsburgh.
Pacific Tool and Supply Co., San Francisco and
Los Angeles.
The W. M. Pattison Supply Co., Cleveland.
Robinson, Cary & Sands Co., St. Paul.

FOREIGN AGENTS

For France, Spain and Belgium: F. Aubert &
Co., 91 Rue de Maubeuge, Paris.
For Holland: Spliethoff, Beeuwkes & Co.,
Rotterdam.
For Australia: McPherson's Pty., Melbourne.

"United States"—Lathes for Service



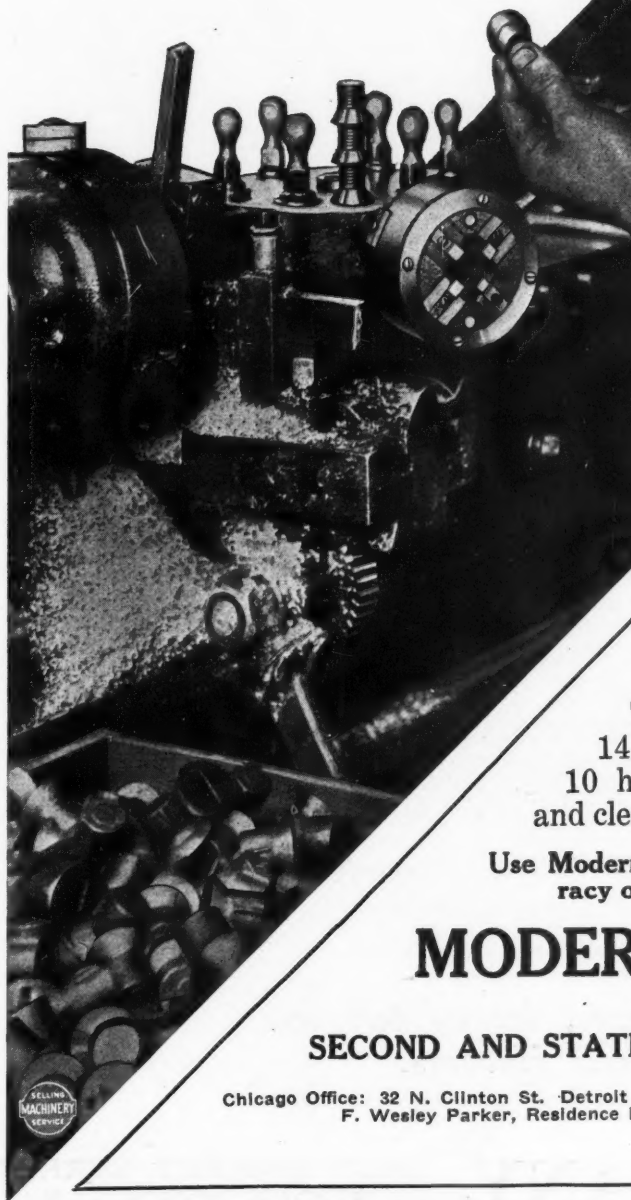
This lathe will not only do all the work that the power of a 4" double leather belt can deliver to it, but will also do such work accurately and with a minimum of effort on the operator. Investigate it.

The United States Lathe & Machine Co.
CINCINNATI, OHIO, U. S. A.

MODERN

Fine Die Heads for Fine Threads

Modern Self-Opening Adjustable Die Heads, recognized as standard for thread cutting, are regularly made in sizes with capacities from 1-16" to 5 1-2" diameter. Larger sizes to order.



Modern Die Heads are found in every conceivable line of manufacture; the photograph illustrating an instance of their adaptability. This picture was secured in the plant of one of the country's foremost safe and vault builders, where all the screws used are threaded by the Modern Die Head.

This particular job is threading $\frac{3}{4}$ " x 1"—14 pitch steel screws. Production is 1600 in 10 hours—every thread perfect in dimension and clean cut.

Use Modern Die Heads for maximum efficiency and accuracy on your thread cutting. Send for the facts.

MODERN TOOL COMPANY

Main Office and Works:

SECOND AND STATE STS.

ERIE, PA., U. S. A.

Chicago Office: 32 N. Clinton St. Detroit Office: 1223 Dime Bank Bldg. New York Office: 2 Rector St.
F. Wesley Parker, Residence Engineer and Export Agent, 2 Rector St., New York.



Here's A Profitable Battery of Farwell Gear Hobbers



Profitable not only in the sense that they do their work well, *but that they do it with remarkable economy.* The machines are nine Farwell Gear Hobbers owned by the Stewart-Warner Speedometer Corporation, Chicago, Ill. The work is forged steel gears, average diameter 4", $\frac{1}{2}$ " face, ranging in pitch from 6 to 8, with special emphasis on accuracy and all the speed possible. Production per day of 8 $\frac{3}{4}$ hours averages 65 gears, each machine. The work is economically done, because a Farwell Gear Hobber never requires all of an operator's time. Once the work is set up and the cut started, the machine requires no further attention till the gear is completed. In many instances one operator looks after four busy machines.

Farwell Gear Hobbers are simple, efficient, powerful, rugged—record producers, profitable machines in every sense of the word.

*If you buy or make gears, let us tell you
more about Farwell Hobbers.*

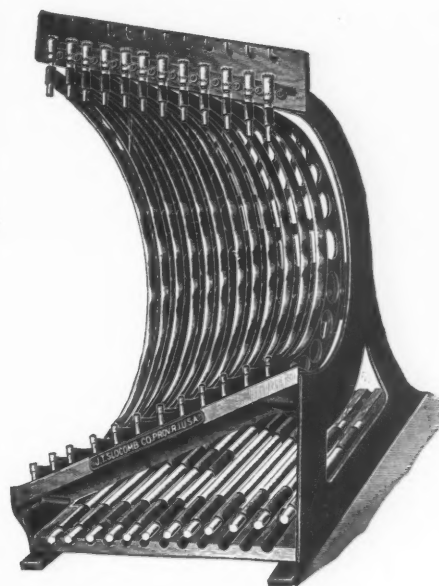
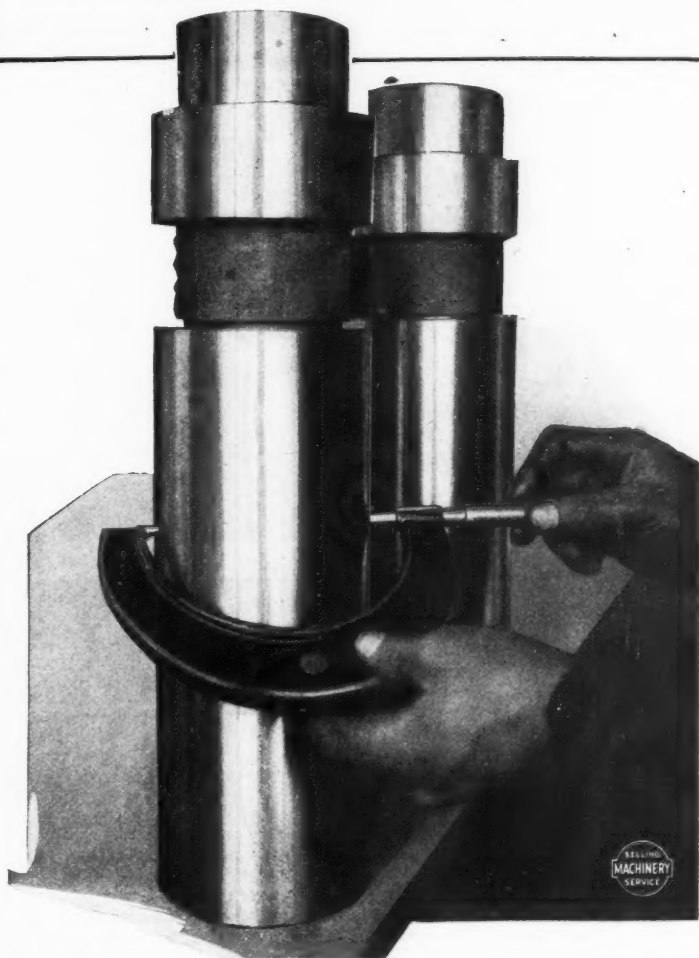
**THE ADAMS COMPANY, 1903 MARKET STREET
DUBUQUE, IOWA, U.S.A.**

What the Slocomb Says is Right—The Inspector Marks O. K.

Requirements were never more severe as to accuracy, and by the same token, never were more Slocomb Micrometers in use. Manufacturers whose business is accurate production are not taking chances—they're making sure. And in an increasing number of cases they are making sure with Slocomb Micrometers, because they meet the current demand.

Slocomb Micrometers are true—absolutely true—with the strength to stand up to the usage popular tools get in busy shops. The drop forged I-section frame combines strength with lightness; the Slocomb screw is hard tool steel working in a nut giving four times the bearing surface found in other micrometers.

The Slocomb is "the longest lived micrometer that can be bought."



No. 28—12 to 24 Inches
Set of Micrometer Calipers

Write for
Catalogue No. 15.

**J. T. Slocomb
Company**
Providence, R.I., U.S.A.

Representatives in England: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow.
Representatives in Japan: Alfred Herbert, Ltd., Yokohama.
Representatives in Italy: Chas. Civita, Milan.
Representatives in Australia: Edwin Wood, Pty., Ltd., Melbourne and Sydney.



BECKER

Milling Machines

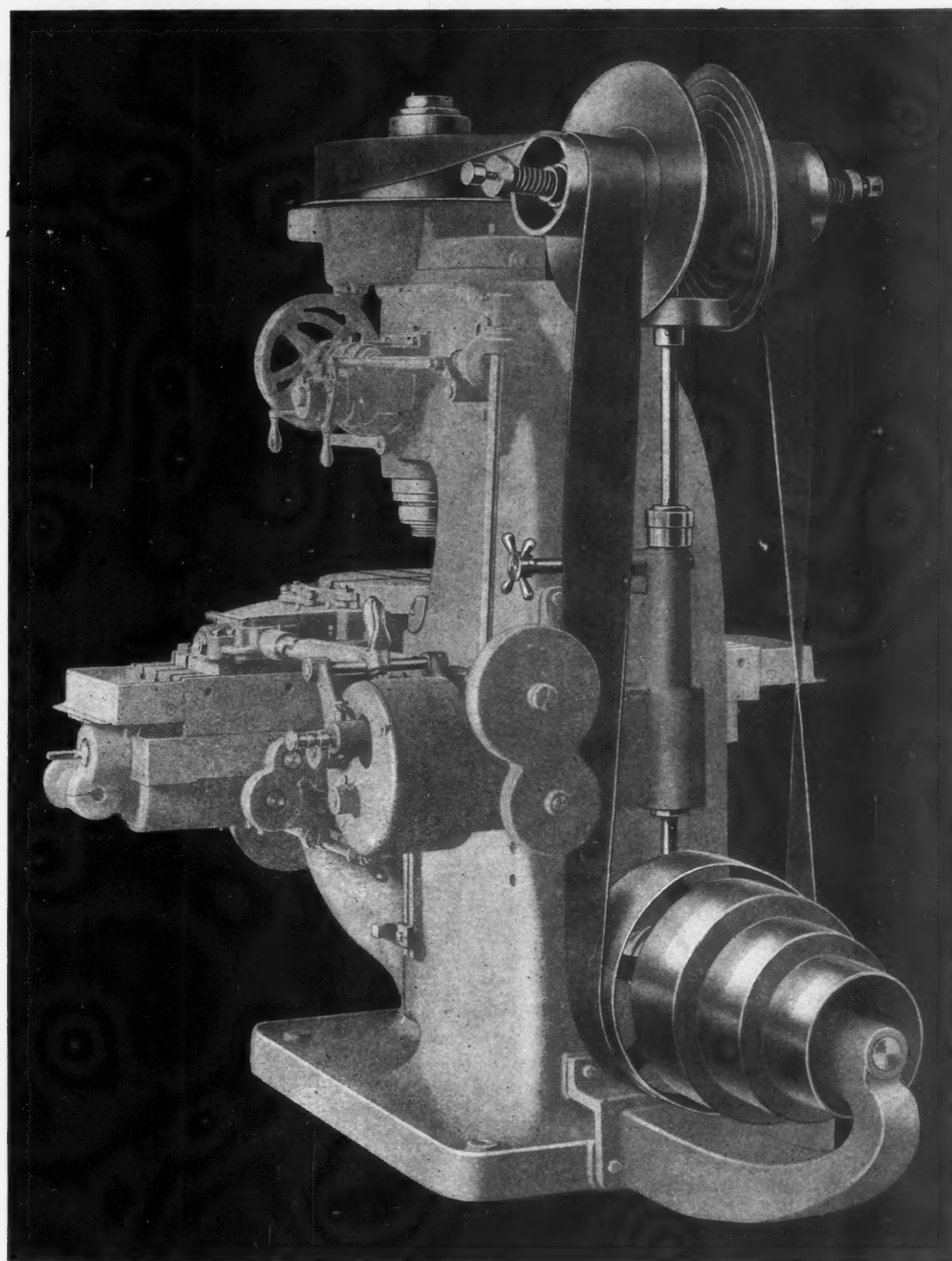
THE DRIVE

Transmission gears—power wasters, noise and trouble makers—have been entirely eliminated from the Becker Drive. A large pulley, driving a wide belt at high velocity, delivers an abundance of power *direct to the spindle*. This gives smoothness and flexibility not possible with a geared drive, besides *saving from one-half to two-thirds of the power*.

The Becker Roller Feed is operated by a cone rolling between two friction discs and held in positive contact by the combined action of powerful springs and the driving belt. Infinitesimal changes of feed are obtainable from .003" to 1.245" per revolution. The increase or decrease is made smoothly and without shock and without stopping the machine. The most profitable feed for every job is always available. We shall be glad to talk over Becker possibilities with you. Write us.

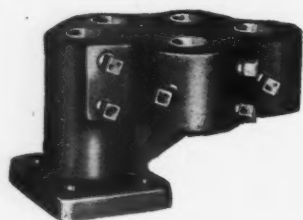
BECKER MILLING MACHINE

AGENTS: Manning, Maxwell & Moore, Inc., New York, Philadelphia, Pittsburgh, Chicago, St. Louis, San Francisco, Seattle, Milwaukee and Cincinnati.



COMPANY, Hyde Park, Mass.

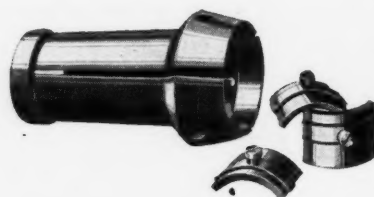
AGENTS: H. B. Slate, Hartford, Conn. National Supply Co., Toledo, O. Selson Engineering Co., Ltd., London, Turin and Melbourne. Allied Machinery Co. of America, Paris.



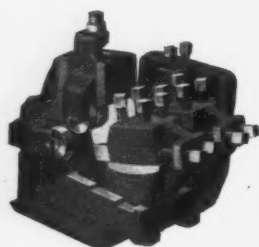
No. 107
Multiple Turning Head



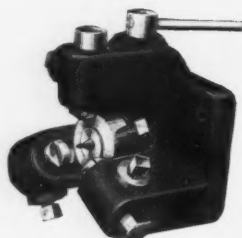
No. 108
Facing Head



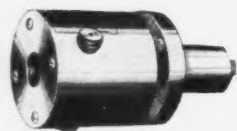
Push-Out Collet with Bushings



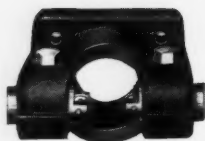
No. 139
Multiple Cutter Turner



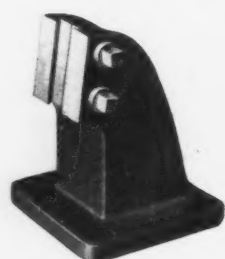
No. 142
Center Drilling Tool



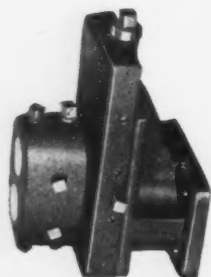
No. 120
Adjustable Drop-off Tap
Holder



No. 143
Knurling Tool

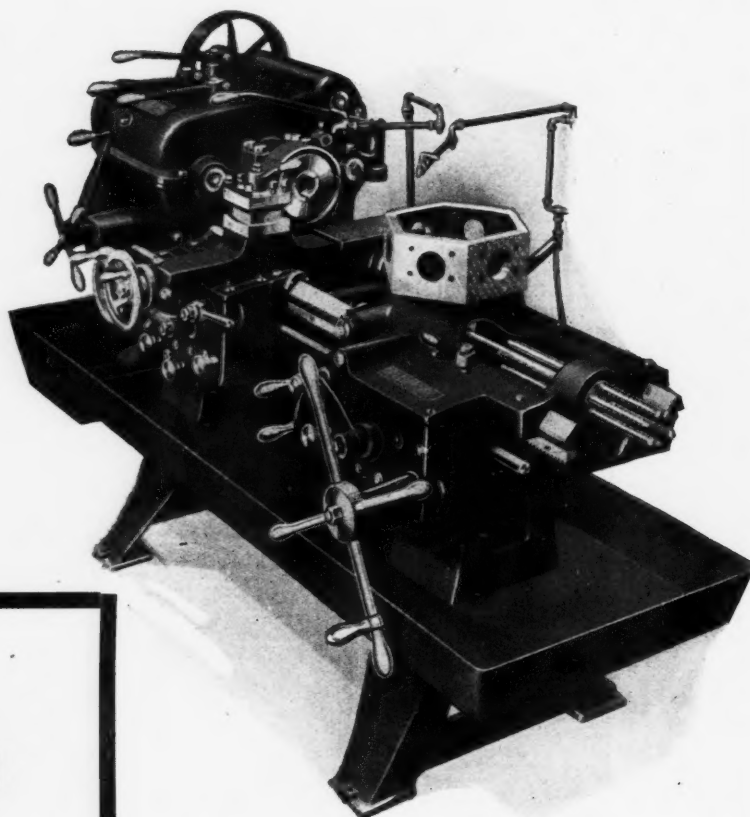


No. 149
Rear Forming Tool
Holder



No. 116
Slide Tool

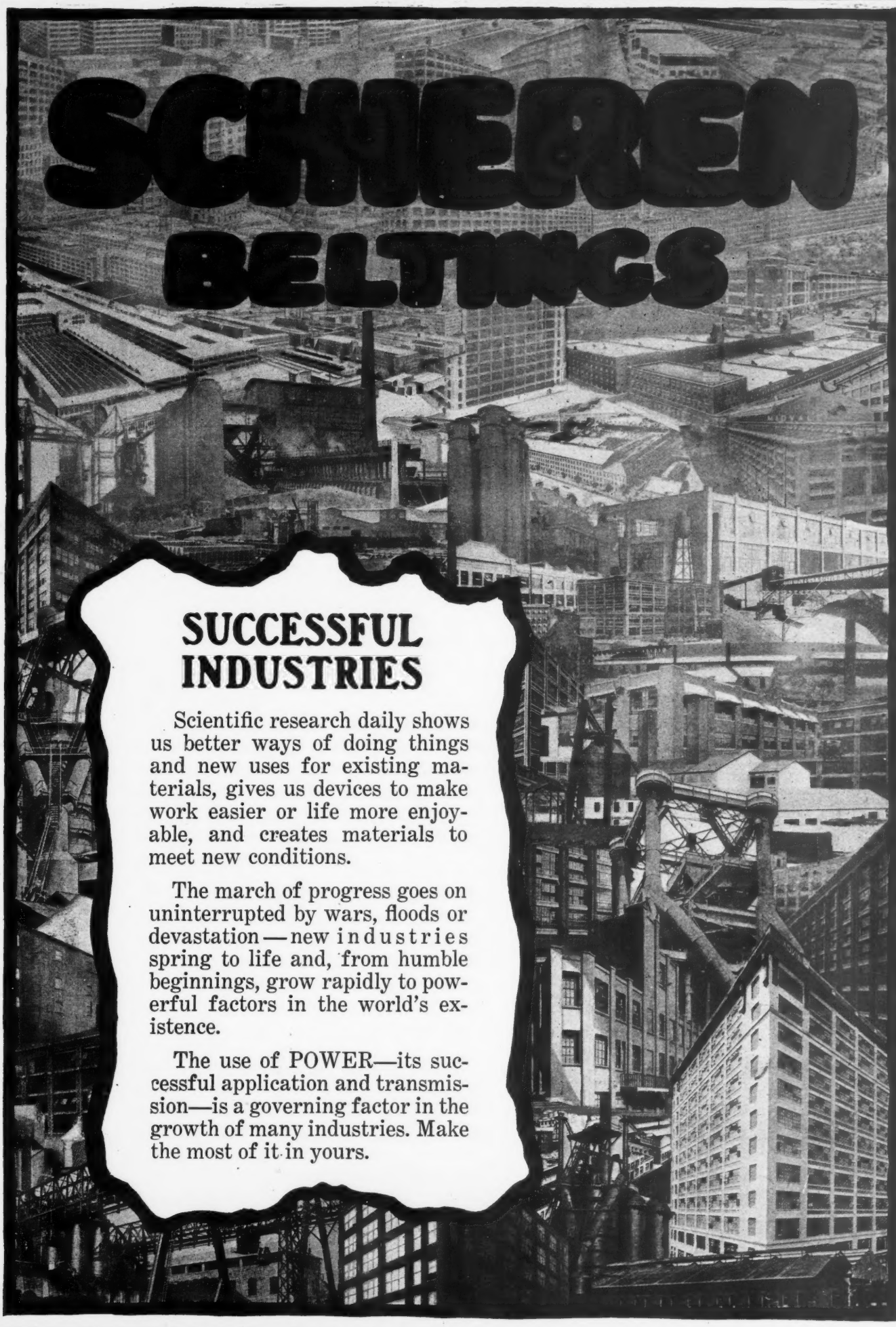
The FOSTER 1-B Universal Turret Lathe with its tools and attachments is establishing a new and higher standard of production per dollar invested. Let us tell you more about it.



The Foster 1-B Universal Turret Lathe

A machine that is adapted for manufacturing in large quantities as well as producing a wide variety of parts in small lots—a machine that brings to its work tremendous power, rigidity and strength. The Foster 1-B is provided with a complete and extensive equipment of standard tools and attachments, and with means for handling work of more or less special nature. Range includes bar and chucking work, from wide forming in steel to turning hard cast iron of large diameter. As many as twelve cutters can be mounted on the two tool carrying units; turret and cross slide can be operated simultaneously and independently with widely different feeds. A carefully devised arrangement of operating helps aids in maintaining a high rate of production.

FOSTER MACHINE COMPANY
ELKHART, INDIANA, U. S. A.



SCHWIEREN BELTINGS

SUCCESSFUL INDUSTRIES

Scientific research daily shows us better ways of doing things and new uses for existing materials, gives us devices to make work easier or life more enjoyable, and creates materials to meet new conditions.

The march of progress goes on uninterrupted by wars, floods or devastation—new industries spring to life and, from humble beginnings, grow rapidly to powerful factors in the world's existence.

The use of **POWER**—its successful application and transmission—is a governing factor in the growth of many industries. Make the most of it in yours.

Practical Economy in Belting Application

As the user and buyer, you know first of all that a belt is needed to transmit so much power from motor, engine or lineshaft to a certain machine.

You have first-hand knowledge of the place it is to go into, and the conditions under which it must operate. Your specifications are final—accepted without question—because you are on the ground and know.

That is the initial step in the application of a belt for transmitting power.

The second step is the selection of the proper belt to successfully transmit the desired amount of power under your conditions.

That is where **Schieren Engineering Service** comes in.

We have not been manufacturing and installing leather belts for more than fifty years without gaining a broad experience and an immense reserve knowl-

edge of what a leather belt will do under any and all conditions.

We know the kind as well as size of belt you should use as soon as we learn your requirements and the conditions of service.

Schieren brands of belting, in all grades, have always stood for honesty in manufacture, and **Schieren Engineering Service**, based upon honesty in application, will not let you buy other than the belt which will most economically meet your requirements.

Half a century of experience and knowledge of belting application, as well as a definite and liberal guarantee as to material and workmanship, will be back of our recommendations on any belting requirements you trust to us, and our complete stocks at convenient centers insure prompt as well as intelligent and reliable service.



Every Belt A DUXBAK

ENTER any one of the hundreds of shops where machines are used in quantity and you confront a veritable "forest" of belt drives.

In such places DUXBAK prevents a multiplication of power losses, and insures uninterrupted *maximum* production. DUXBAK is immune to water and oils and the failings of ordinary belts.

Why not speed-up permanently, as this great shop has done, by using DUXBAK everywhere? They have used nothing else for years.

The House Behind the Dealer

Complete stocks of Schieren Beltings, in all grades, are carried at the following addresses. Your requirements can be taken care of with the utmost despatch, and with the assurance that the reputation of this company will be maintained in every foot of belting sold you.



Chas. A. Schieren Company
ESTABLISHED 1868
Tanners
Belt Manufacturers

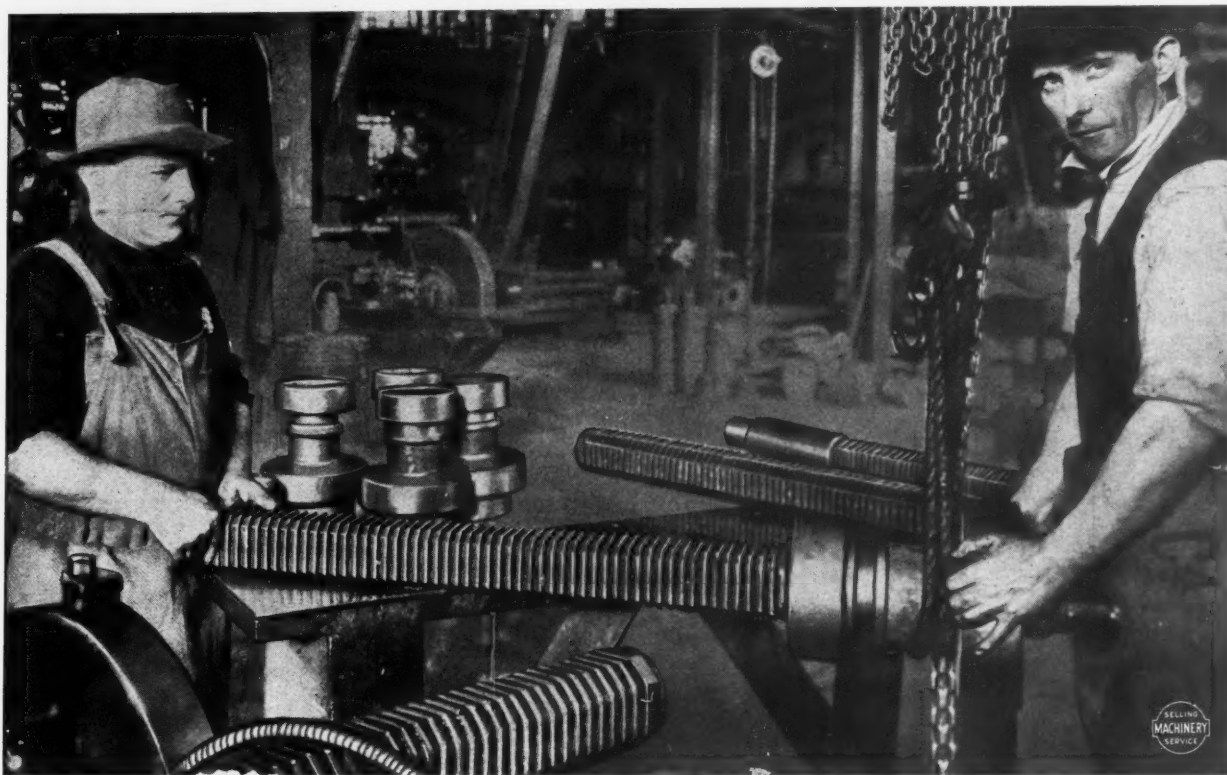
Awarded the Gold Medal of Honor
at the San Francisco Exposition

NEW YORK, 73 Ferry Street

Atlanta, Ga., 272 Marietta St.	Detroit, 72 Congress St., W.
Boston, 232 Summer St., Opp. So. Sta.	Kansas City, 1324-26 West 12th St.
Chicago, 128 West Kinzie St.	Memphis, Tenn., 475 So. Main St.
Cleveland, 777 Rockwell Ave.	New Orleans, La., 404-406 Canal St.
Dallas, Tex., The Texas Chas. A. Schieren Co., Inc., 205 S. Market St.	Philadelphia, 226 North Third St.
Denver, 1752 Arapahoe St.	Pittsburgh, 337 2nd Ave.
	Salt Lake City, 115 West 2nd So. St.
	Seattle, 305 First Ave., So.
	St. Louis, 18 So. Broadway

Oak Leather Tanneries
Bristol, Tenn.





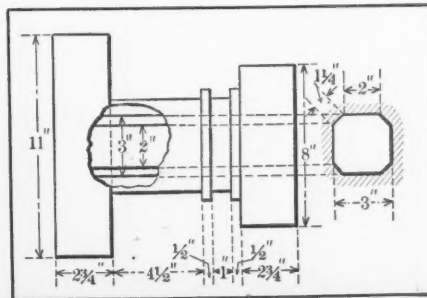
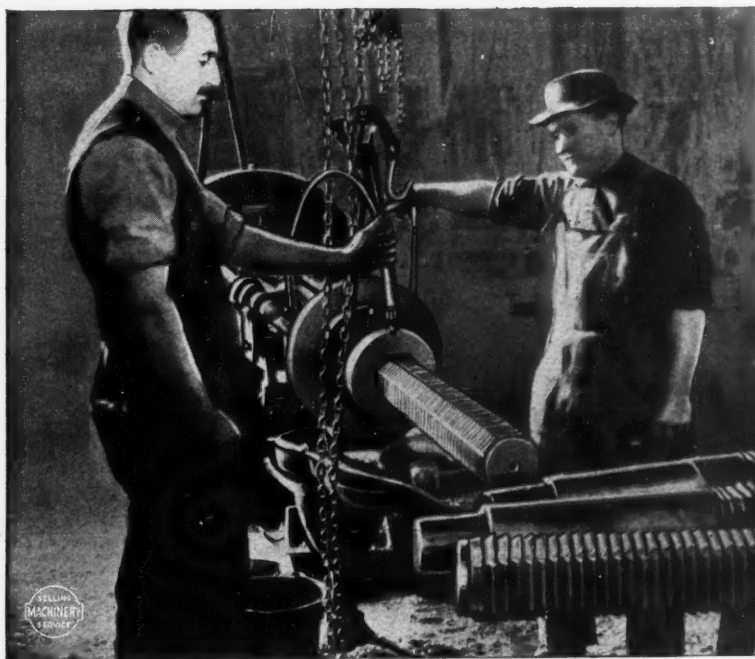
THE broaching machine made by the J. N. Lapointe Co. scores again. At the J. I. Case Threshing Machine Company's plant, this time, broaching the bearings in transmission gears for 40 H.P. gas tractors. The gear is forged steel; bearing is 3" square by 12" long. Four broaches are required, 15 minutes complete the job. The official "communique" is "most satisfactory; profitable commercially."

The fact that we have not only the name but the man himself, Mr. J. N. Lapointe originator of the Lapointe Broaching System, is a sufficient guarantee of the quality of our product.

THE J. N. LAPOINTE COMPANY
NEW LONDON - - - CONN., U. S. A.

Broaching Large Holes Profitably

*Send blue prints, samples or
sketches of your work*





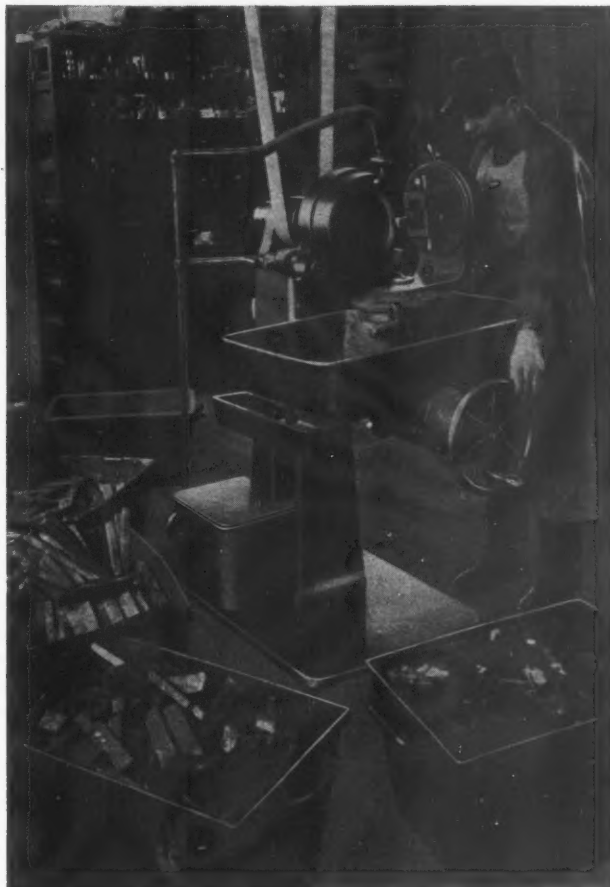
How Much Does It Cost per Year to Grind Your Tools

Never figured it out? It is a bigger item than you would think it could be—we can tell you that much without even knowing how many tools you grind.

Your machinists grind their own tools—every minute they are away from their machines is just so much time the machines are standing idle; every minute a man stands waiting to get at the grinder is just so much of his time wasted. And this waste, this unproductive time, costs many dollars per man each year. It totals an almost unbelievable amount in a big shop.

The Gisholt Universal Tool Grinder does away with this waste. It provides a correct mechanical means for grinding turret lathe, engine lathe, shaper, planer, boring mill and slotter tools—*each tool at its correct cutting angles*. It duplicates its work always. It establishes a standard of correct grinding angles. It keeps machine operators at their posts—eliminates this source of time waste by exchanging correctly ground tools for dull ones as fast as they are needed. There are other advantages; but the principal one is the savings this grinder accomplishes.

Dodge Bros. find it pays to use several Gisholt Tool Grinders; the photograph shows thousands of toolpost tools which have been reclaimed and, properly ground, are ready to be started through the shops again.



This machine gives you many advantages—

- does away with idle machines and non-productive work by machinists;
- stops dull and unused tools from lying around machines;
- cuts down your tool-steel investment by enabling you to get along with fewer tools;
- stops loss of valuable tools;



- gives you the increased production that comes from correctly ground tools;
- gives you the saving that comes from re-forging tools in lots instead of singly;
- gives you general orderliness, the value of which cannot be overestimated.

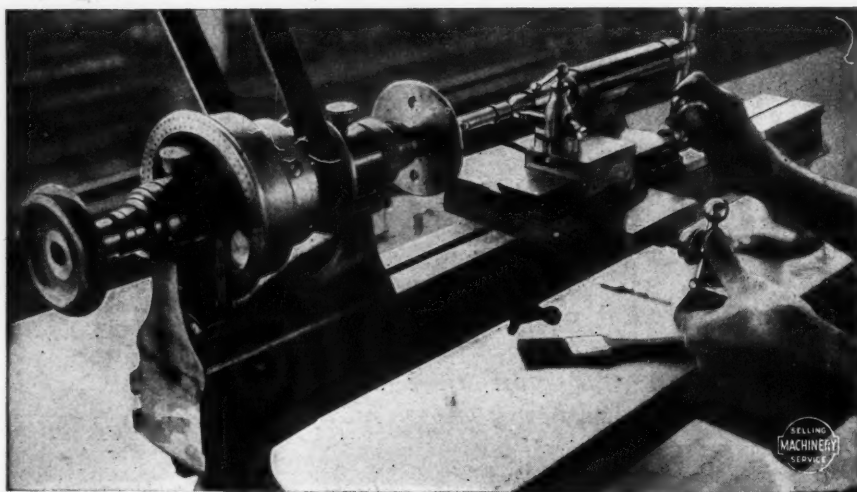
No need to train anyone especially for the work. A boy can learn to operate it properly in a few hours.

1208 E. Washington Ave., Madison, Wis.
NEW YORK CITY

AMES BENCH LATHES

Are All-Around Machines

Ames Lathes are designed and built for precision manufacturing and tool room work. They are carefully put together, rapid, easy to handle and dependable in action no matter how exacting the work. Provided with turret, milling, grinding, drilling, filing and thread cutting attachments, there's practically no limit to Ames usefulness.



*Before you decide on bench lathe equipment
ask us more about Ames Advantages.*

B. C. AMES COMPANY - Waltham, Mass.

LEVER QUICKER THAN SCREW CONTROL



The lever at the center of the apron instantly controls both feeds—whereas a star wheel or knurled knob operates but gradually, and that with difficulty, when the machine is running at a high rate of speed.

With lever control the operator can use power feed right up to the shoulders. This is a distinct time saver and a characteristic feature of

MORRIS LATHES

Morris Lathes, 16, 18 and 22 inches, are made with single and double sliding back gears, special patented apron and four changes of positive feed. Complete specifications on request.

We also make 2½, 3 and 3½ foot Radial Drills.

THE MORRIS MACHINE TOOL COMPANY
CINCINNATI

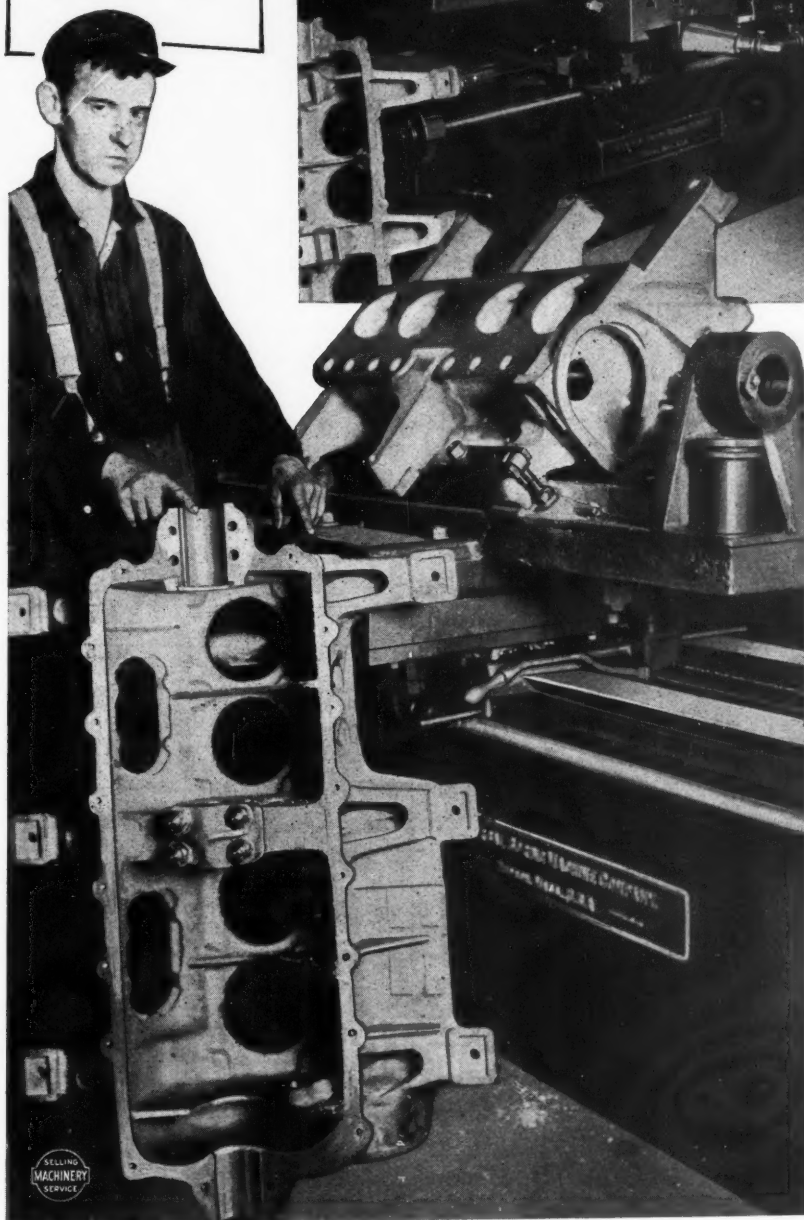
ENGLISH AGENTS:
A. A. Jones & Shipman, Ltd., Leicester, England

OHIO, U. S. A.

Building the Universal Reputation

A Series of
"Cold Fact"
Advertisements
of which this is
No. 11

"Where Accuracy
Counts, We Win"



The casting is mounted on a special boring fixture clamped to the machine table, boring all being done through the two bushed holes shown. The fixture has bushed support in the rear as well as front to facilitate operation and permit the use of the machine without rear support.

Rigidity, convenience, accuracy, durability—five years failed to develop a single weakness anywhere. Why not enjoy records like this, too?

Same Machine Same Work Same Accuracy for the past Five Years

In the plant of the Continental Motor Company, Allentown, Pa., these three Universal Horizontal Boring Machines may be seen handling the same work they were doing five years ago, all showing the same degree of accuracy and high rate of production that characterized their operation then.

The work is on aluminum engine cases for Mack trucks—boring and facing three crank case bearings, three camshaft bearings and drilling two idler gear bearings.

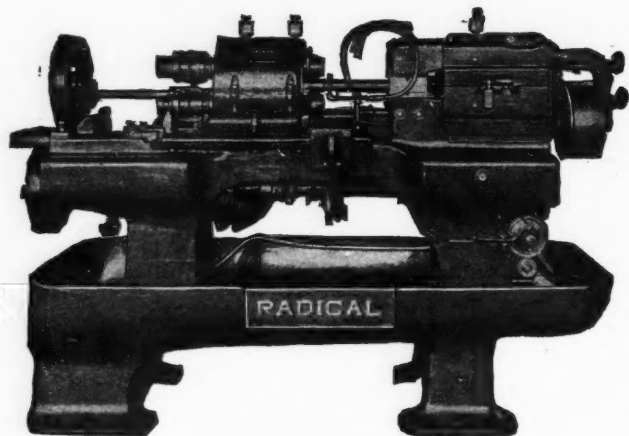
Catalogue on request

UNIVERSAL BORING MACHINE COMPANY
HUDSON MASSACHUSETTS, U. S. A.

RADICAL FITCHBURG AUTOMATIC MACHINE WORKS

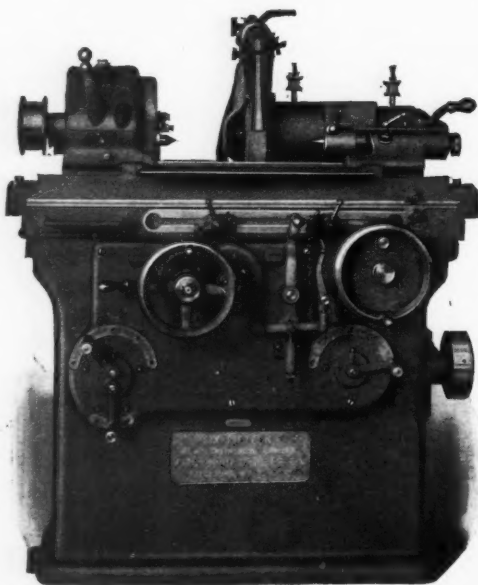
FITCHBURG,
MASS.

We welcome visitors
who want proof that
The
Radical Automatic
is
Built Right



Fitchburg Model "A"

**Compact, Economical
and Rapid Grinding**



No more power or time than is absolutely necessary for accurate results is used in grinding small, cylindrical work—straight or tapered—with a

FITCHBURG SIX-TWENTY

The machine has a wide range of speeds and feeds—made instantly available by centralized control. It is belt or motor driven—according to model—and is equipped with variable table dwell, positive stop, automatic cross feed and all features for economical operation.

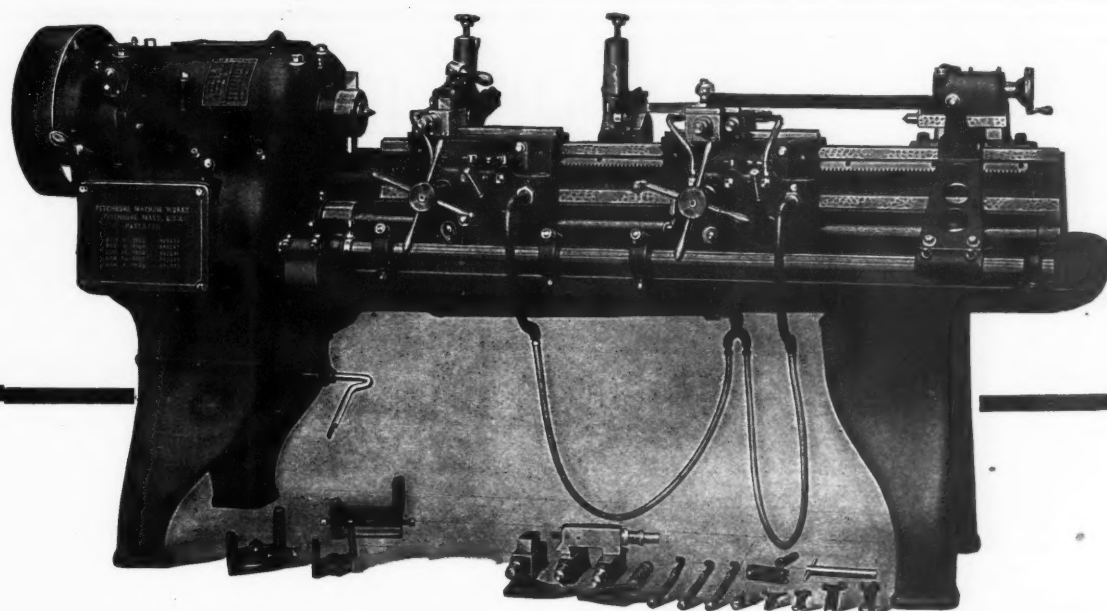
Compact design—requiring very small amount of floor space—adds another count to the good points of the Fitchburg Model Six-Twenty.

Further details in our catalog.

Fitchburg Grinding Machine Co.

76 Winter Street

Fitchburg, Mass.



Turning Rifle Barrels in 2½ Minutes on the *So-swing* Lathe

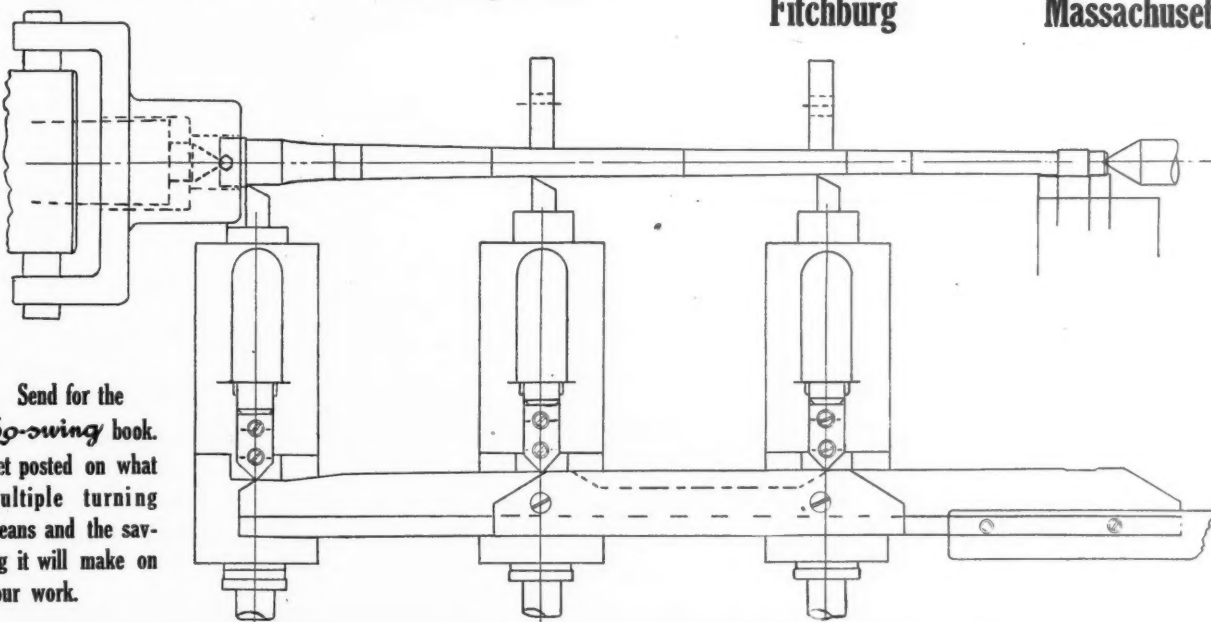
The accompanying sketch shows how the *So-swing* turns rifle barrels at the rate of 2½ minutes apiece in one of the large rifle factories. A rifle barrel is admirably suited to the multiple turning idea, and the set-up shows just how the tools are arranged for handling the turning. Before coming to the *So-swing* Lathe, the barrel is spotted so that the roll rests may support it, and then the cutting tools get in their work. Notice that the extreme muzzle end of the rifle barrel is turned with a necking tool, and then the three tools that turn the tapered and straight sections start in. These tools are guided by a multiple former plate that gives the tapers and straight sections where they are required.

If you are interested in rifle barrel turning, or if you think there is any chance that you may be interested in rifle barrel turning, you will find we can give you some valuable information.

Perhaps your work is far removed from rifle barrel work. Perhaps you're turning camshafts, machine shafts, spindles, distance rods or other shafts that have many diameters. If so, you need to know about the *So-swing* Lathe.

The *So-swing* principle consists in turning simultaneously with a number of different cutting tools, each one of which may be adjusted to turn some particular diameter. There are two sizes of *So-swing* Lathes, one which takes work up to 3½ inches diameter and the other up to 8 inches diameter, and you can get any bed length required for your work.

Fitchburg Machine Works
Fitchburg Massachusetts



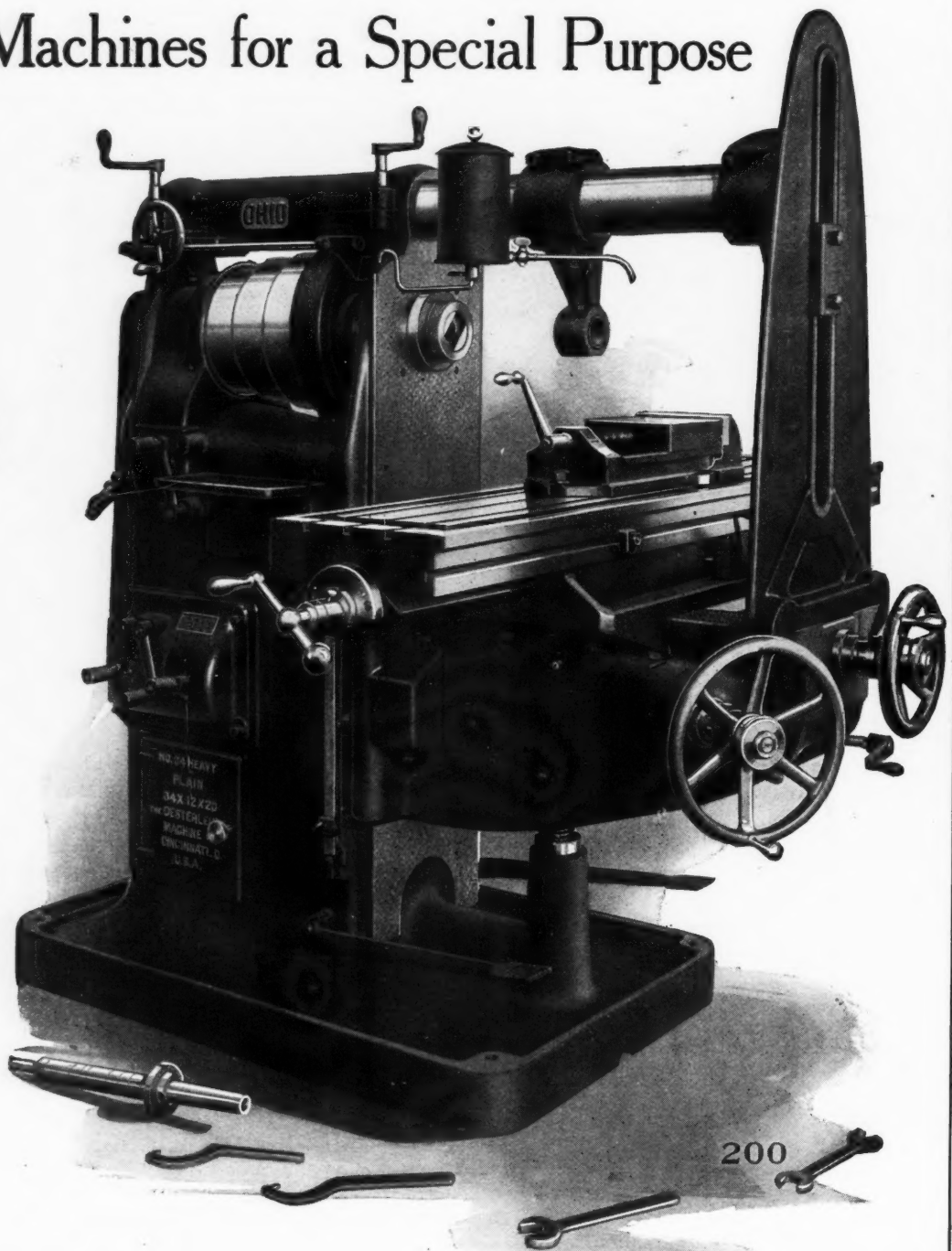
Send for the
So-swing book.
Get posted on what
multiple turning
means and the sav-
ing it will make on
your work.

OHIO MILLERS

Machines for a Special Purpose

OHIO
Millers

OHIO
Grinders



WE have spent years of time and barrels of money in developing Ohio Millers for one special purpose—the low cost manufacture of such work as comes within the range of a knee type milling machine.

Ohio Millers possess the capacity, the structural power, the speed, convenience and accuracy necessary for maximum outputs at minimum costs. If you manufacture you can't find better machines. Let us tell you more about them.

The
Oesterlein
Machine
Company

Cincinnati
Ohio, U.S.A.



Designers and Makers of Milling Cutters, Hobs, Dies, Jigs and Fixtures

If you use hobs and milling cutters of any shape or size we can make them for you.

If you have hobbing, gear cutting and milling problems to solve, our engineering department, which can give expert advice in this line, is at your service.

Michigan Tools are made right to form and carefully heat treated, insuring good work and long service.

MICHIGAN TOOL CO.
DETROIT, MICHIGAN



At the Industrial Exposition and Export Conference

THE First Annual Industrial Exposition and Export Conference of the Allied Industries of the United States of America (that's the complete and official title) at Springfield, Mass., during the last week in June, was a most interesting and instructive affair.

The seriousness with which the problem of export trade was tackled and the character of the discussions on this subject were particularly gratifying.

Van Norman Machine Tools

were exhibited at Springfield. There is no reason why these tools shouldn't prove as popular on foreign soil as they have here. They are adaptable machines, highly accurate, with many exclusive features—popular because they are efficient.

Hand Milling Machines; Duplex Milling Machines in three sizes; Grinding Machines in seven types for grinding internal ball-race grooves, end thrust rings, external grooves, straight and taper holes, etc., etc.

Let us send circulars on any or all of these machines.



**Van
Norman
Machine
Tool Co.**

Waltham Avenue

Springfield,
Mass., U.S.A.

NATIONAL



**THE NATION
PREPARED**

**NATIONAL
Twist Drills and
Tools play no
small part in
this gigantic
undertaking**

**NATIONAL TWIST DRILL
& TOOL CO.**
Detroit · Mich.

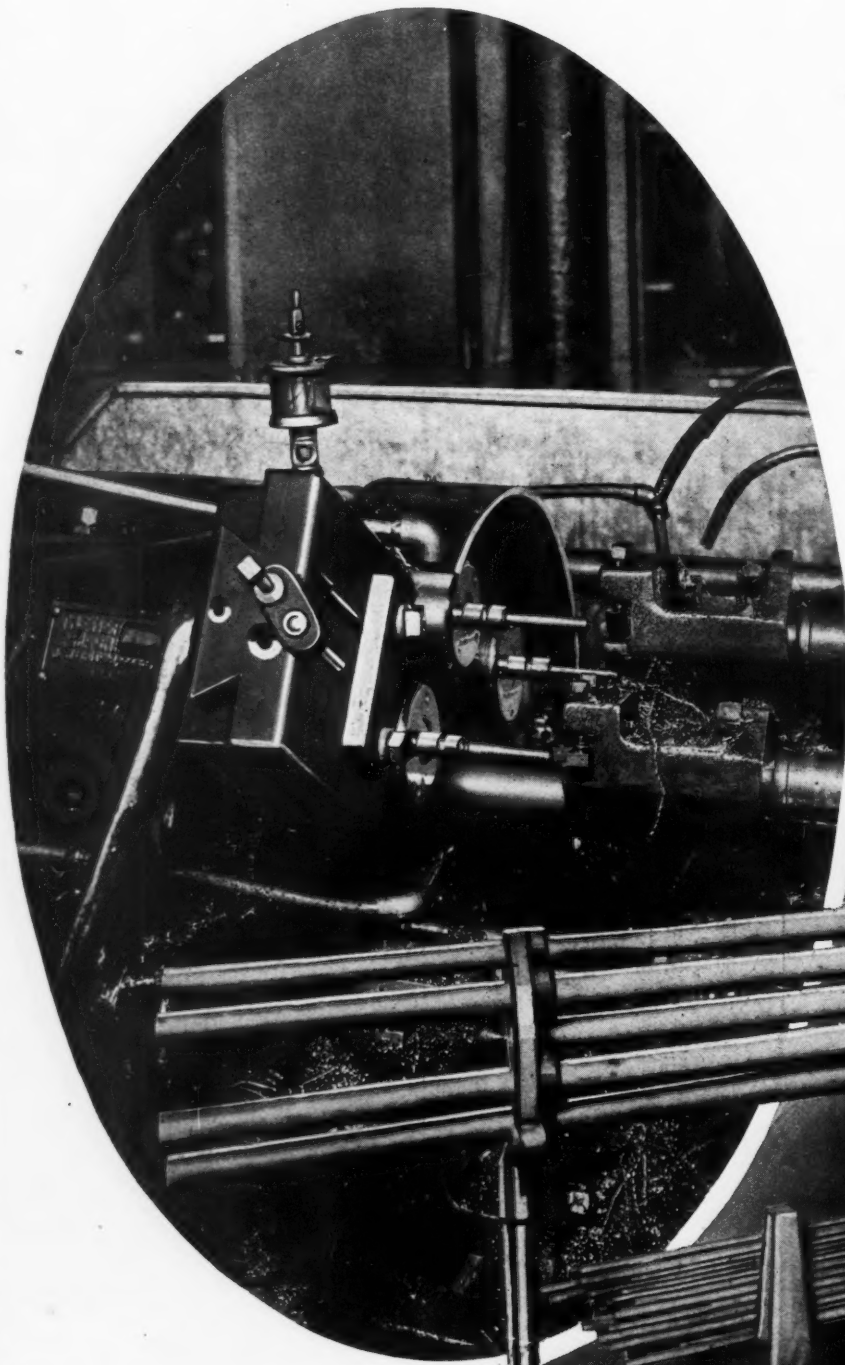
NATIONAL
TWIST DRILL
& TOOL
CO.

NEW YORK OFFICE
50 CHURCH ST.

CHICAGO OFFICE
104-106 SOUTH JEFFERSON ST.

"NEW

**Making the
Worm Shaft
for Stewart-
Warner Speed-
ometers**



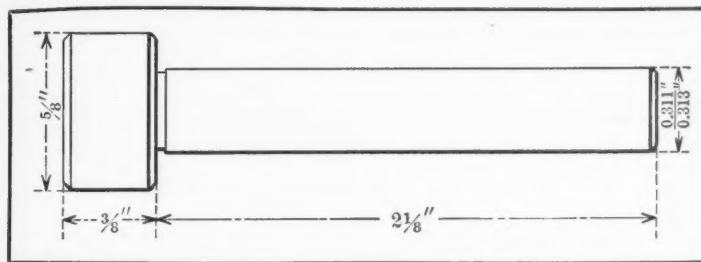
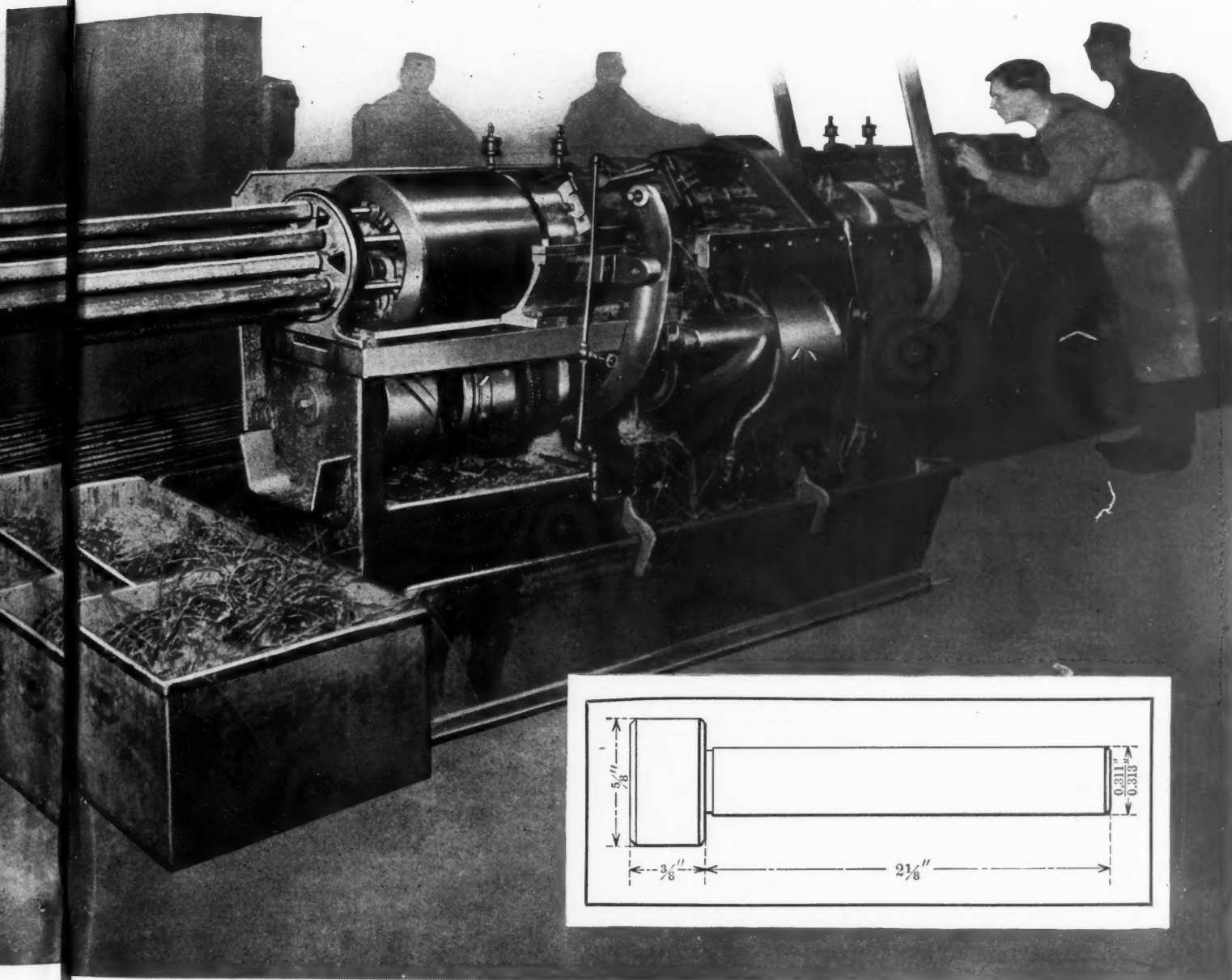
THE NEW BRITAIN MACHINE

BRITAIN SIXES"

In every Stewart-Warner speedometer there's a worm-shaft that looks like the sketch below before the worm is cut. It is made from $\frac{5}{8}$ " round cold-rolled steel, and the turned dimensions are held to a tolerance of 0.002".

"New Britain" Six-Spindle Automatics produce these worm-shafts as well as other similar parts for the Stewart-Warner people. Two "New Britain Sixes" are shown—one operator taking care of both machines. The order of operations is as follows: First, feed stock; second, form; third, fourth and fifth, mill with box tool; sixth, cut off. Production is 220 pieces per hour from each machine. This remarkable output is made possible by the "New Britain's" unequalled tooling capacity, which permits the use of three box tools for milling the shaft.

Attention is called to the fact that, whereas it was formerly necessary to grind these shafts, the "New Britain" turns them out so smooth and accurate as to obviate the necessity of this extra operation. If you are not familiar with the advantages of the "New Britain," send samples of blueprints for estimates of "Six-Spindle" production.



CO., New Britain, Conn., U. S. A.

Foote-Burt High Duty Drills

**Machines
you are
Going to
Need**

*Write for the
Bulletin before
you order
drilling
equipment*



With all the forces of the United States organized for offense and defense, American manufacturers are facing the busiest and most important period of industrial history. Their prime need is machines—good machines, machines built like the Foote-Burt No. 25 High Duty 24" Drilling Machine.

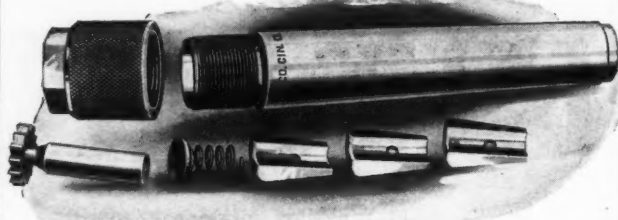
The No. 25 is as rigid as a machine can be made, modern to the smallest detail, and drives high speed drills, up to 3" size, to full cutting edge capacity. All speed and feed changes are made through quick change gear device of special design; spindle is of forged high carbon steel, fitted with ball bearing thrust of our own design, *guaranteed not to crush under the severest duty*. All levers are within easy reach. Briefly, the function of this machine is to work hard and keep at it.

THE FOOTE-BURT CO., Cleveland, Ohio

MILWAUKEE OFFICE, 424 Wells Building.

DETROIT OFFICE, 806-8 David Whitney Building.

FOREIGN AGENTS: Buck & Hickman Ltd., London, Birmingham, Manchester and Glasgow. Moscow Tool & Engine Co., Moscow, Ing. Ercole Vaghi, Milan. R. S. Stokvis & Zonen, Ltd., Rotterdam. R. S. Stokvis & Fils, Brussels. Glaenger & Perreaud, Paris, agents for France, Switzerland, Spain and Portugal. Benson Bros. Ltd., Sydney, Australia, agents for Australia and New Zealand. Mitsui & Co., agents for Japan, Korea and Manchuria. With. Sonesson & Co., Ltd., Malmö, Sweden and Copenhagen, Denmark.



How Do You Hold Your Woodruff Keyseat Cutters and Other Tools with 1/2" Straight Shanks?

LOOK

This chuck is made with a taper shank either B & S or Morse to fit the spindle of your machine. The design is such that the jaws do not fall together, but allow free entrance of the shank at all times.

Send for our catalogue and get acquainted with our tools.

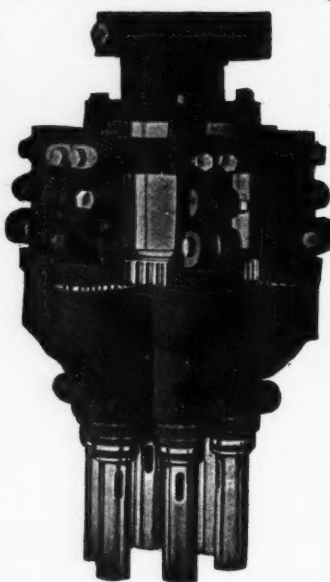
THE ADVANCE TOOL CO.

Canal & Jackson Sts., Cincinnati, Ohio

Agents wanted in all principal cities

With the Covington, Eight Holes Cost No More than One

This Multiple Drill Head is a "sure fire" production booster. It changes single drill output



to multiple in a minute's time and with practically no additional expense. The head, furnished with from 2 to 8 spindles, can be easily adjusted to any upright drill press from 20" to 36" in size, or to large radials, and each spindle "stays put" after adjustment. The Covington is sturdily built throughout, handles a great variety of drilling, gives lasting service.

Circulars and Free Trial Offer
Sent on Request

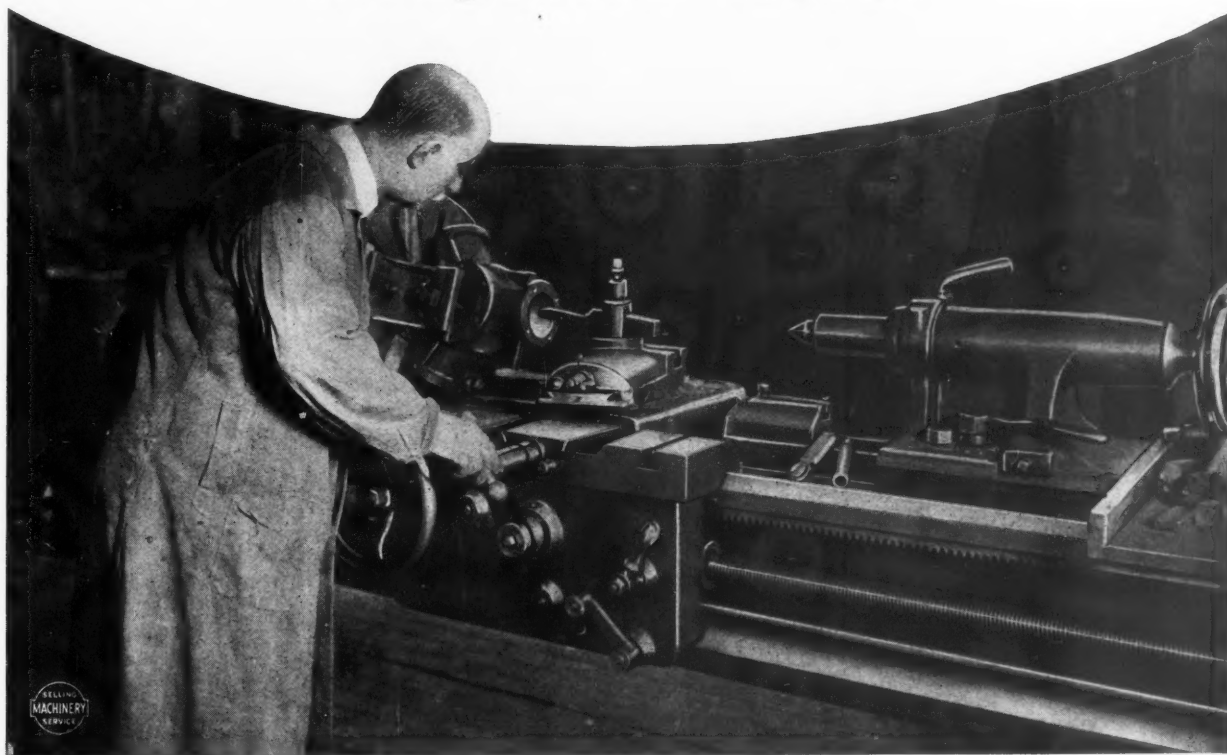
Covington Multiple Drill Company

2449-53 W. McMicken Ave.

CINCINNATI, OHIO

THE ROULSTED TWENTY

On Jobbing Work—an Adaptable Lathe



The Barbour-Stockwell Company, Cambridge, Mass., makes good use of the Roulsted Lathe. When the investigator paid the company a visit recently, here's what he saw. A cylinder casting for an oil engine strapped on an angle iron on the faceplate of the Roulsted ready to be bored out. Three cylinders were bored, the casting being re-set for each operation. Aside from the quick work of the lathe, the overhang from the faceplate is the interesting feature of this job. Roulsted spindle construction, however, is a marvel of strength. It will support work adequately at even a greater distance from the faceplate.

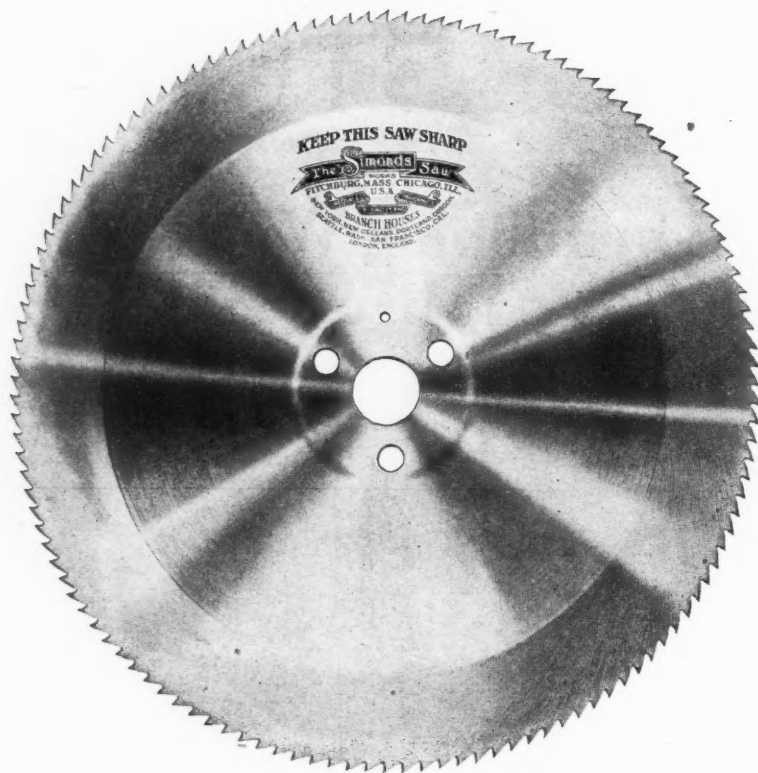
The Roulsted Twenty is a heavy all-around engine lathe, built by specialists. Carriage has full length bearing on the vees; apron is of double-plate type. Actual swing over bed 21", over carriage 14".



*If the Roulsted Lathe is new
to you ask for details*

EXCLUSIVE SELLING AGENTS

HILL, CLARKE & COMPANY, Inc.
BOSTON, MASS., 156 Oliver St. NEW YORK CITY, 136 Cedar St.



SIMONDS

METAL CUTTING SAWS

Every firm using Metal Cutting Saws, Metal Slitters, Screw Slotting Saws, or Inserted Tooth Metal Saws, should find an opportunity to prove to itself that the Simonds Special Blades, which we now manufacture in large quantities, of our own steel and in our own factories are unquestionably superior and economical saw blades.

Write for Metal Saw catalog.

Simonds Manufacturing Company

"THE SAW MAKERS"
FITCHBURG, MASS.

(ESTABLISHED 1832)

17th Street & Western Ave.
CHICAGO, ILL.
NEW YORK CITY
PORTLAND, ORE.
LOCKPORT, N. Y.
VANCOUVER, B. C.

NEW ORLEANS, LA.
SAN FRANCISCO, CAL.

St. Remi St. & Acorn Ave.
MONTREAL, QUE.
MEMPHIS, TENN.
SEATTLE, WASH.
ST. JOHN, N. B.
LONDON, ENGLAND

WOOD WORKERS BENCHES



**If You Can Use a Bench at all,
You Can Use the Best One Made,
to the Best Advantage**

Our "B" Bench as illustrated has for years been the standard. Made of thoroughly kiln dried maple, except the vise screws, which are of second growth hickory.

Tops, exclusive of vises, are 75 inches long, 24 inches wide, $2\frac{3}{4}$ inches thick, with 7 inch recess. Height 33 inches. Has two iron stops. Head vise is 18 inches wide and opens 12 inches. Tail vise is 6 inches wide, opens 10 inches. Weight 190 pounds.

We also carry all kinds of vises, hand screws and clamps and wood working tools and accessories, and, of course, our full line of metal working tools and bolts, nuts, screws, etc., etc.

Send for Catalog No. 86 of "Benches."

HAMMACHER, SCHLEMMER & CO.

HARDWARE, TOOLS AND SUPPLIES

NEW YORK, Since 1848

4th Avenue and 13th Street

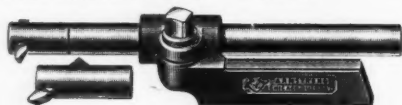


ARMSTRONG BORING TOOLS

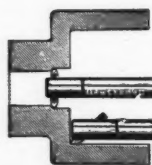
Use High Speed Steel efficiently and economically, and are made in a range of sizes suitable for all classes of work, light or heavy

Single Screw, Quick Action Boring Tool

always ready to use, very stiff, will bore close up to shoulder or bottom. Strain of cut tightens cutter. 7 sizes.



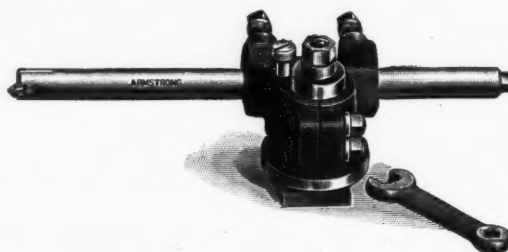
This cut shows Double Ended Cutter roughing out cored hole; also angle cutter boring and facing end.



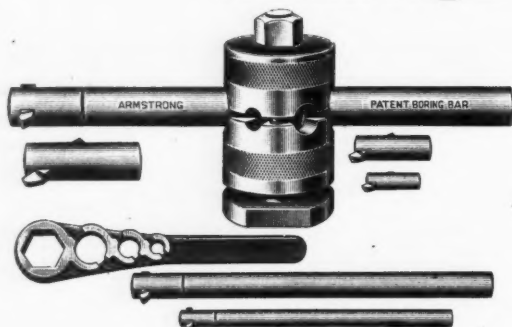
Showing Tool cutting an internal thread

Armstrong Adjustable Boring Tool

This tool combines Convenience, Adjustability and Rigidity to a remarkable degree and is well adapted to a very wide range of work. The holder is easily adjustable to different heights and will hold bars of various diameters. The bars are made from high carbon steel seamless tubing of heavy gauge and are extremely stiff. The cutter can be adjusted and solidly fixed at various angles for boring, facing or turning. Made in four sizes.



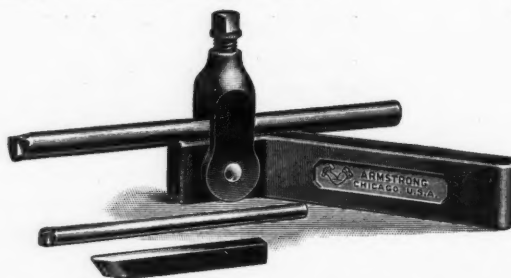
Armstrong 3-Bar Boring Tool



The many points of advantage of this lathe attachment will be appreciated by practical machinists. A slight turn of one nut releases or fastens both bar and holder. Bars can be changed as needed almost instantly, thus allowing the operator to use the stiffest bar possible for each job, with the result that speeds and feeds can be increased and time saved. Made in four sizes.

Armstrong Boring Tool Holder For Small, Light Boring, Threading, Etc.

This tool will be found very handy in the tool room or in boring work of small internal diameter, threading, brass turning, etc. The boring bars furnished are made from the best tool steel properly hardened, tempered and ground ready for use. The holder is reversible, and can be used for turning either right or left hand. Made in four sizes.



A Boring Tool for Every Requirement. Write for Catalog.

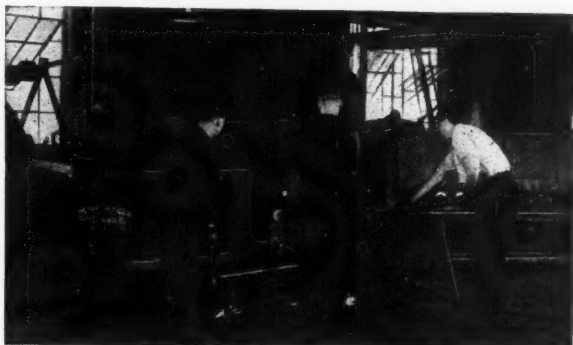


“Doing Their Bit”

In this time of the nation's need, AJAX, like every manufacturer, takes a pretty careful inventory to find out just where he is helping and where he can help more. This is the result.

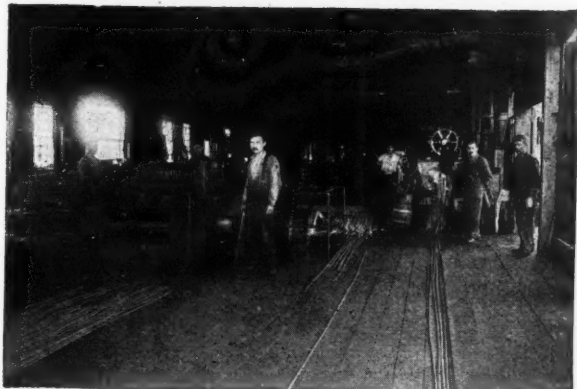
A J A X

Trade Mark Registered



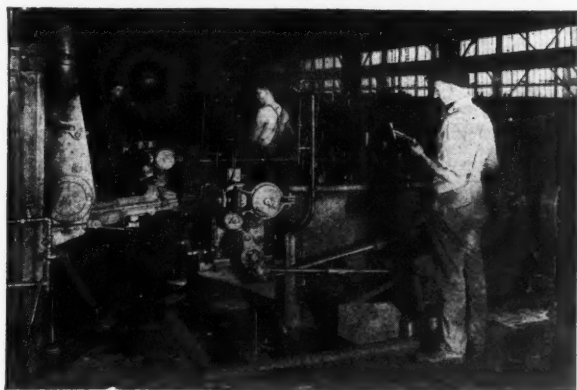
Forging Machines

They are not only playing an essential part in rapid production of actual fighting equipment, rifles, shrapnel, etc., but they are speeding up production and cutting cost in railroad shops, automobile plants, implement factories and other vital industries.



Reclaiming Rolls

On the country's biggest railroads, these rolls are turning scrap into new bars at a rate of 6 to 25 tons per day. They increase by that much the amount of steel available and release an equal tonnage for use in other vital industries.



Heading Machines

They are producing rivets and bolts, especially for ship building, car building, track work, etc., at the rate of 28,000 to 42,000 per ten hour day. The rivet is a small but a mighty important factor in this part of Uncle Sam's program.

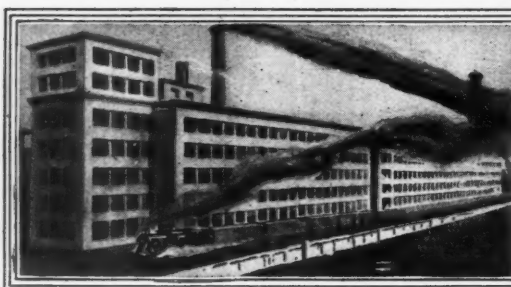
Put your war production problem up to Ajax Engineers—they can, and will, give it special attention

THE AJAX MFG. COMPANY

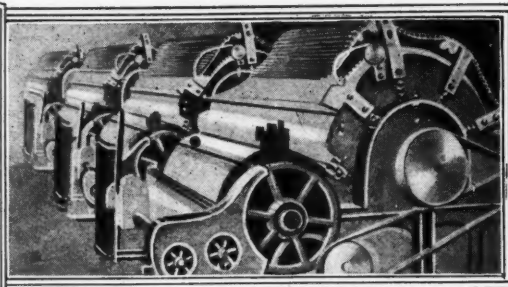
621 Marquette Bldg.
CHICAGO, ILL.

CLEVELAND, OHIO

1369 Hudson Terminal
NEW YORK CITY



Machinery is the biggest factor in the present war. America needs every machine and every machine operating at its highest efficiency. This is a war of resources.



Your Machinery is *Now* a National Asset

America is facing the task of feeding, clothing and equipping her Allies. Every wheel in America must be kept turning. Every machine must be regarded as a national asset and be kept "fit."

You know the resources of this great country. Do you realize the need of conserving them?

Consider the nation's oil supply. It must not be wasted, for America needs every drop of oil she can produce. Every plant owner can perform a national service by avoiding waste in lubrication.

Every plant owner must be economical in his purchase of oils.

He must be economical but not pennywise. Use good oils. It is real economy. Be sure you get the oil best suited to your needs. Thousands of dollars, and thousands of gallons of oil can annually be saved by eliminating the "hit or miss" method of using and purchasing oils.

For every power plant, for every phase of the production of electrical energy, there is *one best oil*. Its use means a better manufactured article, greater production, less wear and tear on equipment and reduced overhead. The present crisis demands that you keep all these considerations in mind.

SWAN & FINCH COMPANY

We feel that sixty-five years' experience in the oil business qualifies us to be of real service to manufacturers of the nation in this crisis.

We know that scientific attention to oil problems will save large sums to the nation and all its manufacturers. And so we offer to help American industry maintain its topmost efficiency. We have an engineering department composed of men who know oiling problems from A to Z. These men have studied the oils you should use for various processes in your plant. Their advice will save oil and money and increase your plant efficiency. It is free for the asking.

Write us full details of your plant equipment, so that our engineering department can make individual recommendations. Or, if you prefer, we will send you booklets on the various phases of oiling and lubrication, indicated below.

Just mark what you want on the attached coupon and return to us.

SWAN & FINCH COMPANY, 165 Broadway, New York City. Please send booklets checked.

- | | | | |
|--|--|---|---|
| <input type="checkbox"/> Engine Lubrication | <input type="checkbox"/> Dynamo and Motor Lubrication | <input type="checkbox"/> Ice Machine Lubrication | <input type="checkbox"/> Tempering Oils |
| <input type="checkbox"/> Steam Cylinder Lubrication | <input type="checkbox"/> Compressor Lubrication | <input type="checkbox"/> Car Journal Lubrication | <input type="checkbox"/> Core Oils |
| <input type="checkbox"/> Crank Case Engine Lubrication | <input type="checkbox"/> Shafting Lubrication | <input type="checkbox"/> Printing Press Lubrication | <input type="checkbox"/> Wool Oils |
| <input type="checkbox"/> Turbine Lubrication | <input type="checkbox"/> Machinery Lubrication | <input type="checkbox"/> Automobile Lubrication | <input type="checkbox"/> Leather Oils and Greases |
| <input type="checkbox"/> Gas Engine Lubrication | <input type="checkbox"/> Spindle and Loom Lubrication | <input type="checkbox"/> Cutting Oils and Compounds | <input type="checkbox"/> Plater's Cleaning Compound |
| | <input type="checkbox"/> Transformer and Oil Switch Insulation | <input type="checkbox"/> Grease—Where and why? | |

☐ Please send your representative to personally discuss lubrication of the machinery checked.

Personal Name.....
 Firm Name.....
 Address..... M-8



Celfor Drills

Are Good Tools

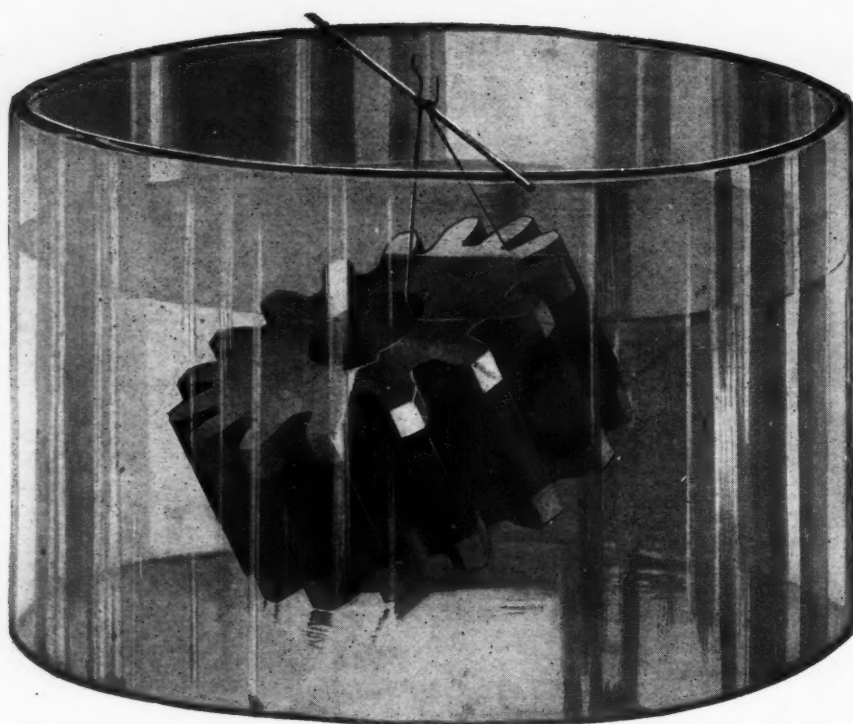
For manufacturing, they are particularly good tools. That's the opinion of the Goulds Manufacturing Company of Seneca Falls, N. Y.—and they ought to know.

The picture shows a set-up of Celfor Drills nosing their way through the flange of a 5 $\frac{1}{4}$ " x 16" Triples Plunger Pump. Eight drills find their way through a solid two-inch flange in one minute and forty-five seconds—and only one grinding each day.

That is drill economy and a production record of an unusual sort—yet common enough for Celfor Drills. The Goulds people use them on every job where holes are $\frac{1}{2}$ " or over. There are sound reasons why. Let us tell you of them.

**CLARK
EQUIPMENT
COMPANY**

Successor to
CELFOR TOOL COMPANY
BUCHANAN, MICHIGAN, U.S.A.



It Must Be a Fabroil Gear

Convince yourself of the ability of a **Fabroil Gear** to withstand atmospheric changes.

Put it through "the third degree." Immerse it in water—or oil. Heat it on the radiator and put it out in the cold. Turn a steam jet on it. Prove it to your own satisfaction.

Fabroil Gears come out of tests like these unchanged, retaining all their excellent qualities. You never have to guard against deterioration by long storage; consequently you can stock **Fabroil Gears** with perfect safety and so guard against loss of time in the day of accident or rush orders.

General Electric Company

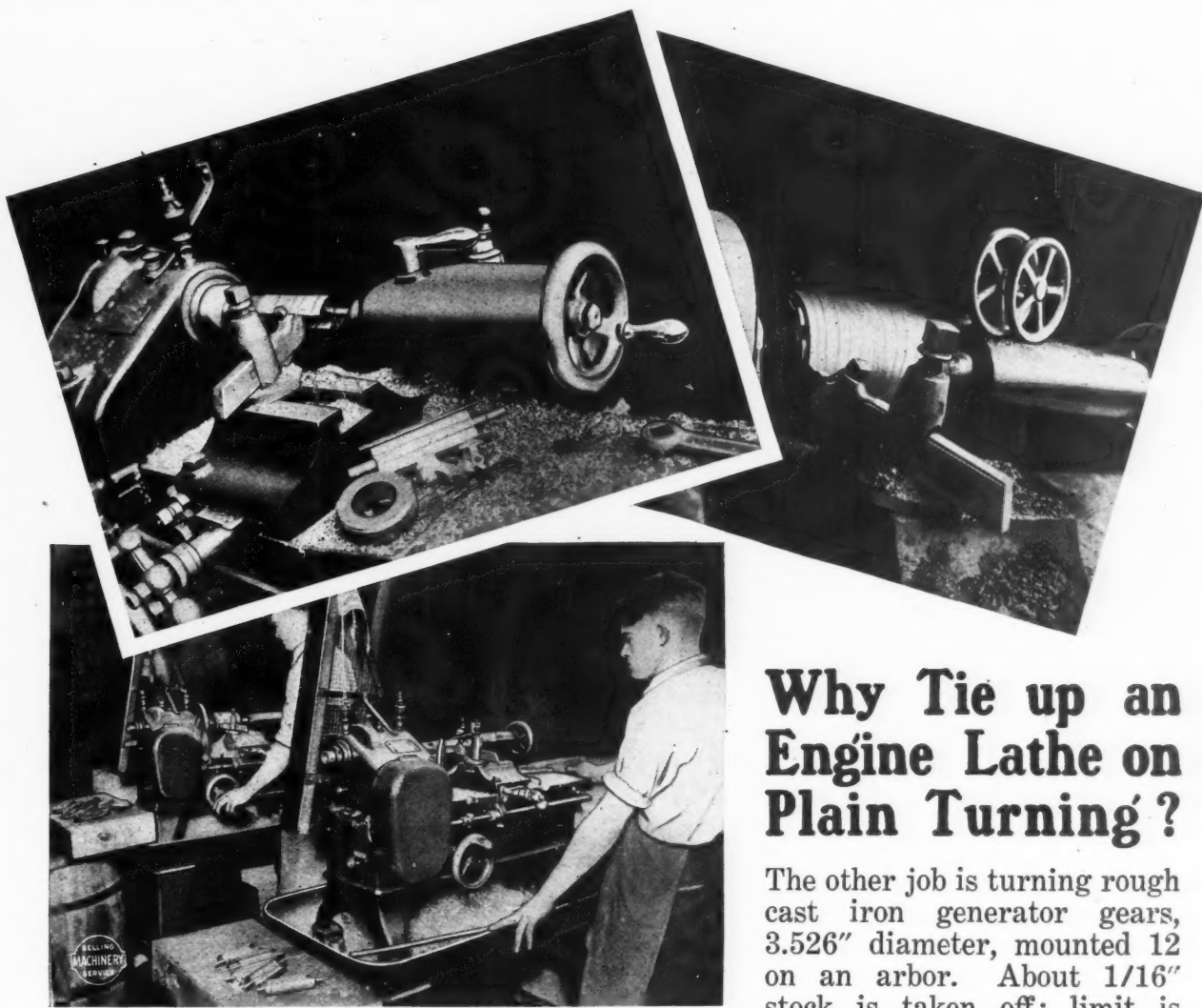


General Office: Schenectady, N. Y.

Sales offices in all large cities



5814



The P-C Manufacturing Lathe

Just as fast, just as efficient and immeasurably more economical is the Porter-Cable Manufacturing Lathe. Here are two P-C Lathes at the Stromberg-Carlson Telephone Manufacturing Company's plant, Rochester, N. Y. One is turning armatures; (92 punched steel blanks) the cut is intermittent; the diameter must be 1.480", held with a 0.001" limit. The operator starts the cut across the armature at a speed of 140 r. p. m. and a feed of 0.040" per revolution, and goes right on filing armatures that have already been turned. All he does to the machine is take off finished work and start new work.

Why Tie up an Engine Lathe on Plain Turning?

The other job is turning rough cast iron generator gears, 3.526" diameter, mounted 12 on an arbor. About 1/16" stock is taken off; limit is within 0.001" of standard size. When the blanks are finished the operator takes them, arbor and all, over to the two gear cutting machines that cut the teeth. He keeps them going in addition to his P-C Lathe and is by no means overworked.

Porter-Cable Manufacturing Lathes are practical, hard-working machines. They take big cuts, turn big chips, insure big output. They save money on work not over 9" diameter by 18" long, and are ideal for duplicating parts in quantity.

We'll be glad to go over P-C advantages in detail and tell specifically what our machines are doing for others. Write us.

The Porter-Cable Machine Co.
SYRACUSE **N. Y., U. S. A.**

Foreign Representative: Benjamin Whittaker, 2 Norfolk Street, Strand, London

AMERICAN GAS FURNACES

The Sure Furnaces

No guesswork with these machines—a heat treating operation under "American" Gas Furnace methods is an assured success. Every factor necessary for the proper handling of expensive material has been assured—perfect temperature control by means of our Automatic Controller, even fuel consumption, and quick, uniform, direct heating. This furnace for annealing, hardening and case-hardening is typical of "American" construction and a sure producer of high-grade work.

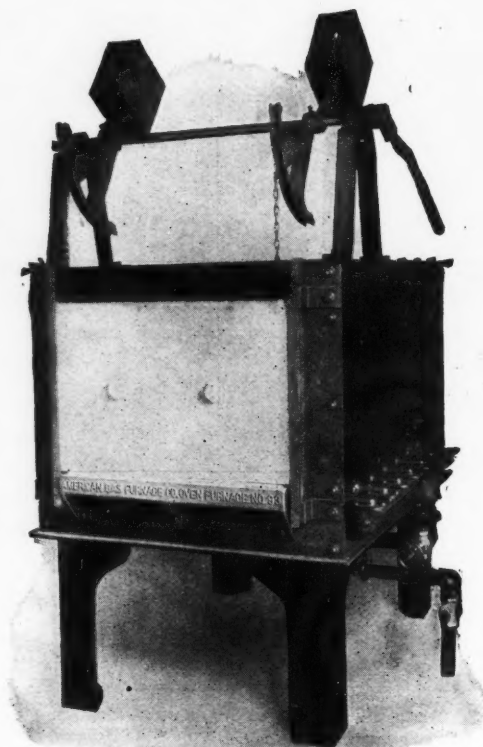
We make furnaces for every heat treating purpose and they're all listed in the catalog. If you're interested in better heat treating results, get a copy and select "sure" furnaces for your work.

American Gas Furnace Co.

ENGINEERS AND MANUFACTURERS

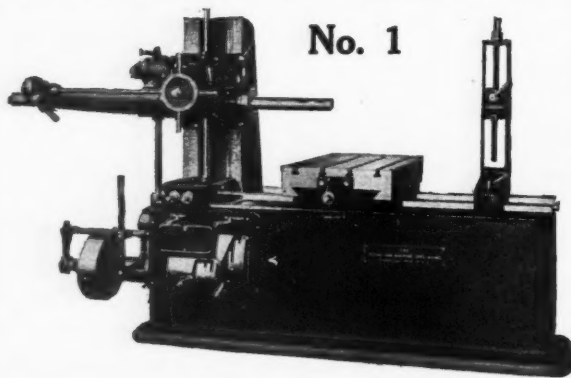
24 John Street

New York City



Made in Various Sizes

Cleveland Horizontal Boring, Milling and Drilling Machine



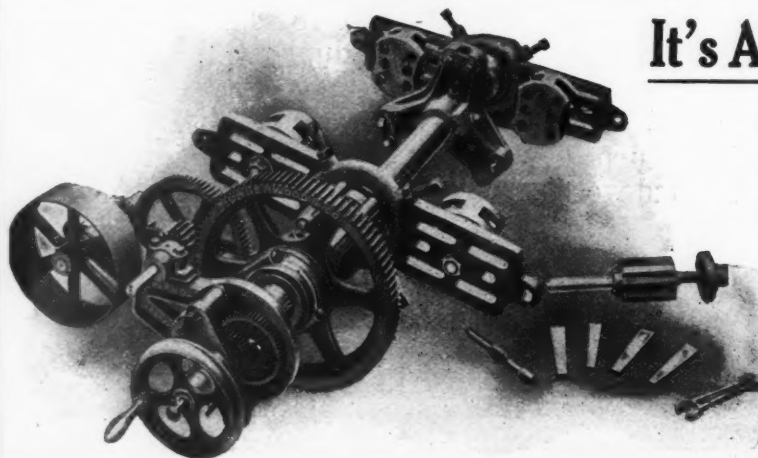
No. 1

In this machine all the handles are conveniently located and are operated from a natural working position. A single handle provides a complete change of either feed or speed, the same pilot wheel controls both slow hand feed and quick traverse of the bar; all speed and feed changes are made while the machine is running, spindle can be stopped, started and reversed instantly. There are 16 feeds and 12 speeds, all gears are steel and fully enclosed.

Full details on request.

The Cleveland Machine Tool Works

CLEVELAND, OHIO, U. S. A.



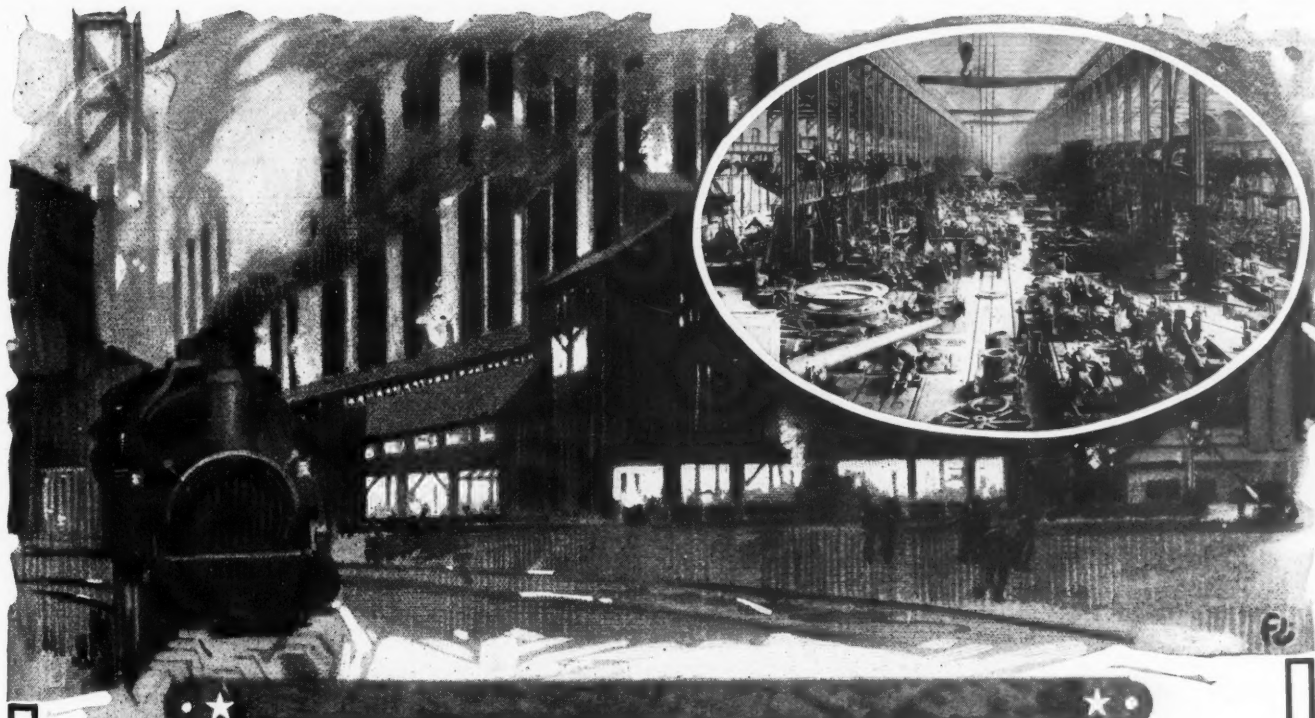
It's Always Well to Be Prepared

Don't run the risk of having to shut down every time a cylinder needs reboring—Add an UNDERWOOD PORTABLE BORING BAR OUTFIT to your equipment. No need to dismantle the machine—simply remove the piston, attach the Underwood and bore.

We designed this machine primarily to fill a need in our own shops and are confident there is work enough for it in yours to keep it busy between emergencies.

Send for Complete Catalog of Underwood Tools

H. B. UNDERWOOD & CO.
PHILADELPHIA Est. 1870 PENNSYLVANIA



BETHLEHEM CUTS STEEL WITH FASTEST CUTTING HACK SAWS

THAT the Bethlehem Steel Co. uses STAR BLADES is vitally significant for every manufacturer who saws metal. Because every tool the famous Bethlehem plant uses has first had to prove beyond question its ability to help extend their output to the last notch.

You who are buying hack saw blades to-day—whether machine or hand blades—must realize that in last analysis you are not buying blades at all but the output those blades will give you. It is not a question of getting blades at the lowest cost, but of getting blades that *will give you the maximum number of cuts at the lowest cost.*



STAR HACK SAW BLADES



Machine and Hand

Flexible and All Hard

were the first modern blades ever manufactured, and for thirty years they have held their quality supremacy. Hundreds of thousands of tests have been made to determine out of thousands of combinations exactly what relative dimensions, what shape and setting of teeth and what kind and hardness of steel would give the best cutting results.

Our special automatic machinery with its gauges to the finest limits makes possible a uniform quality of production that ordinary methods could not give and an unbelievable quantity production at a minimum of factory cost. It is significant that the present standard practice with other hack saw makers was abandoned by us more than twenty years ago

for more efficient methods. The Star line includes machine and hand blades—flexible and all hard for every purpose. Whatever your metal sawing problem, there is a Star Blade that will give you the greatest cutting efficiency at the smallest blade and time cost.

Prove this fact for yourself by making the most drastic tests or place the burden of proof on us and we will demonstrate the greater efficiency in Star Blades to your thorough satisfaction. The more difficult the problem, the more we will welcome the chance to show you.

Address our Engineering Department at 200 River St., Millers Falls.

\$500.00 FOR YOUR EXPERIENCE

Our position as authorities on metal sawing efficiency has made us a national clearing house of information on the results blade users are getting under all classes and kinds of conditions. To encourage this clearing house idea, we offer \$500.00 in gold for the best articles on "How I Test Hack Saws." Tell us your methods in detail (either on machine or hand blades) and give us

1st Prize	\$250.00
2nd Prize	100.00
3rd Prize	50.00

your conclusions with absolute truth and frankness, including some of the records of your results. It is not necessary to be a Star user to win a place in this prize award. We want your experience whatever it is. Get your reply in as early as possible. The best replies will be published in book form and in our advertising. Contest closes November 30.

4th Prize	\$25.00
5th Prize	15.00
6th to 11th Prizes	\$10.00 each

Manufactured by CLEMSON BROS., Middletown, New York
MILLERS FALLS CO., Millers Falls, Mass.

SOLE DISTRIBUTORS

LEES - BRADNER

COLLET TYPE THREAD MILLERS



Part of the Total Installation of Lees-Bradner
The Accepted Standard For Munition Manu

THESE machines will cut a full thread up to a shoulder. In operation there is no reversal of rotating parts so that no time is lost on account of back lash. The lead screw is reversed once for about fifty pieces. These Collet type thread millers are adapted for milling internal or external

THE LEES-BRADNER COMPANY

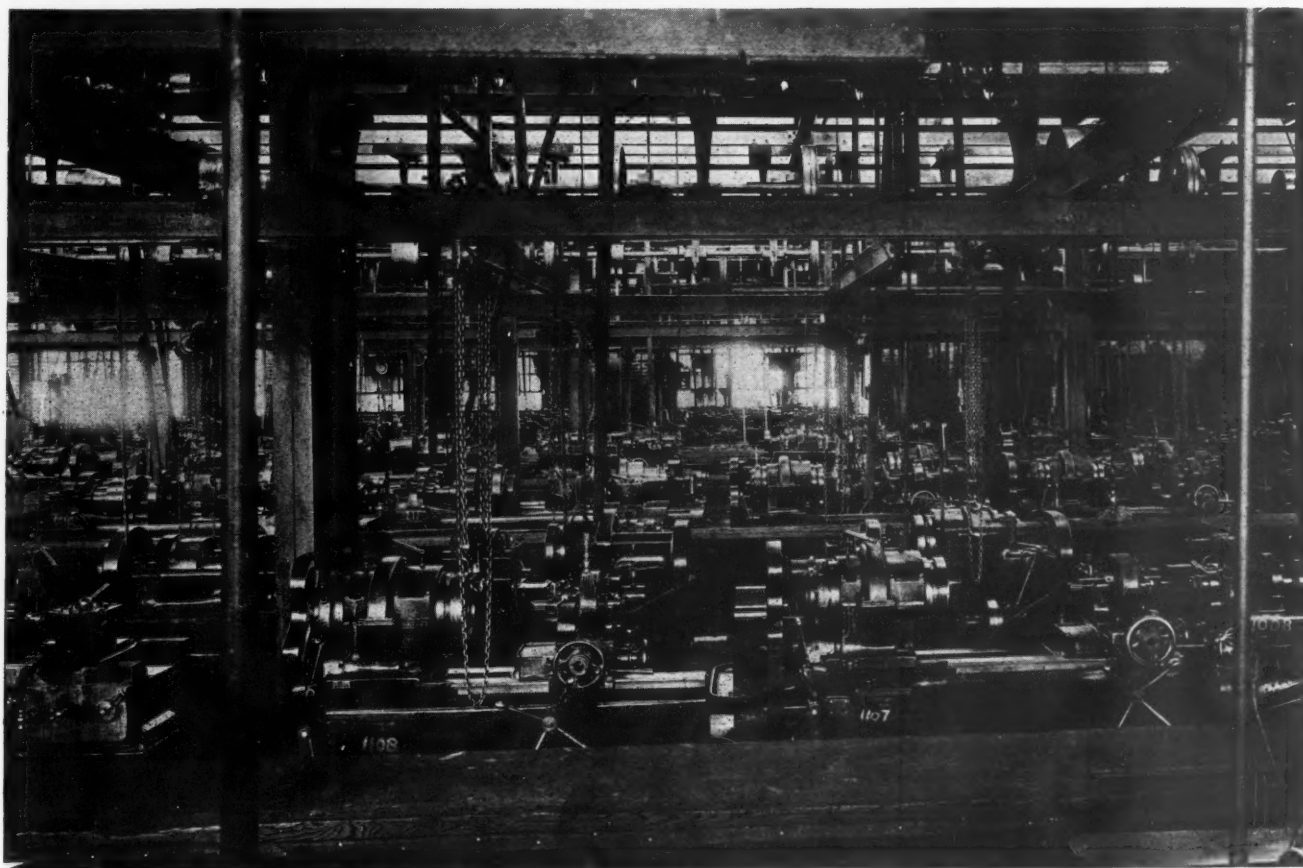
THREAD MILLERS

CLEVELAND, U. S. A.

GEAR GENERATORS

LEES - BRADNER

COLLET TYPE THREAD MILLERS



Collet Type Thread Millers in One Plant
facturers; Approximately 1000 in Operation

threads with a hob type cutter in one revolution of the work. The work is supported in a positive opening and closing Collet. Remarkable accuracy and production are obtained. Built in sizes up to 9½-inch Collet capacity. Send us blue prints of the work under consideration.

THE LEES-BRADNER COMPANY

THREAD MILLERS

CLEVELAND, U. S. A.

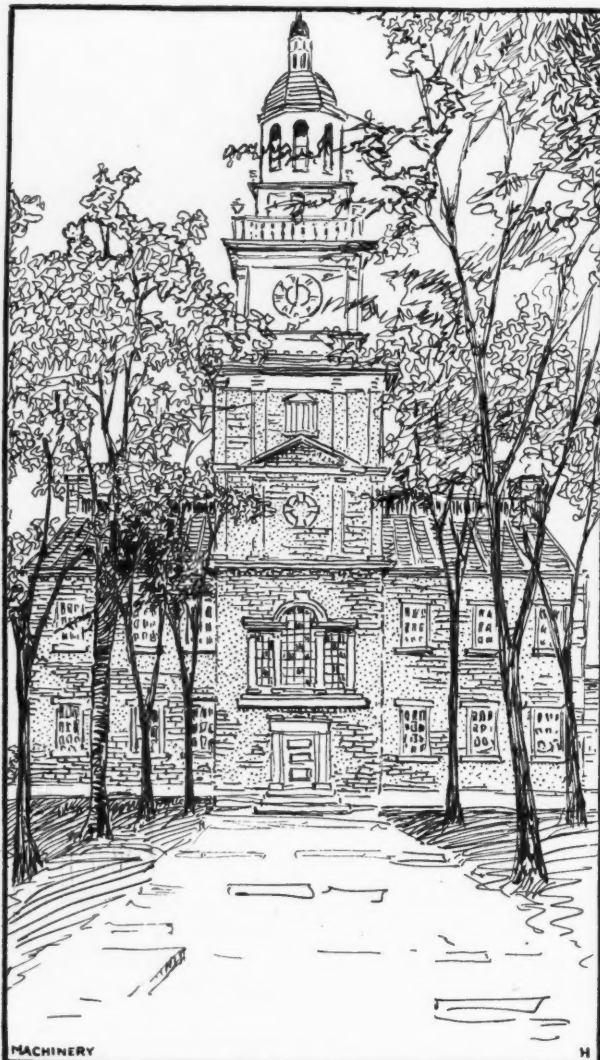
GEAR GENERATORS

Two Stories of American Independence

ONE is the story of National Independence and goes back to 1776 when the Signers of the Declaration proclaimed America free.

The other has to do with industrial independence—the freeing of American manufacturers from the handicap of uncertain supplies. The new country needed steel products of the highest grade. Hermann Boker & Company did their part to establish and maintain an adequate and accessible supply of the world's best steel specialties on American shores.

Right now we are pushing Gibraltar—"The Tool Steel without a risk." We recommend it, without qualification, for threading dies, taps, chasers, punches and dies, reamers, milling cutters, form cutters and other uses where high speed steels are unsatisfactory. We stake our reputation upon Gibraltar Tool Steel. In the 80 years of our experience we've never seen anything better. Try it. Ask for the booklet.



Independence Hall

NOVO SUPERIOR

The Steel without an equal.

NOVO

The standard in high-speed steel.

INTRA

The non-shrinking tungsten alloy tool steel.

GIBRALTAR

The tool steel without a risk.

H. BOKER & COMPANY, Incorporated

Successors to HERMANN BOKER & COMPANY

101 DUANE STREET

NEW YORK, N. Y.

CLEVELAND

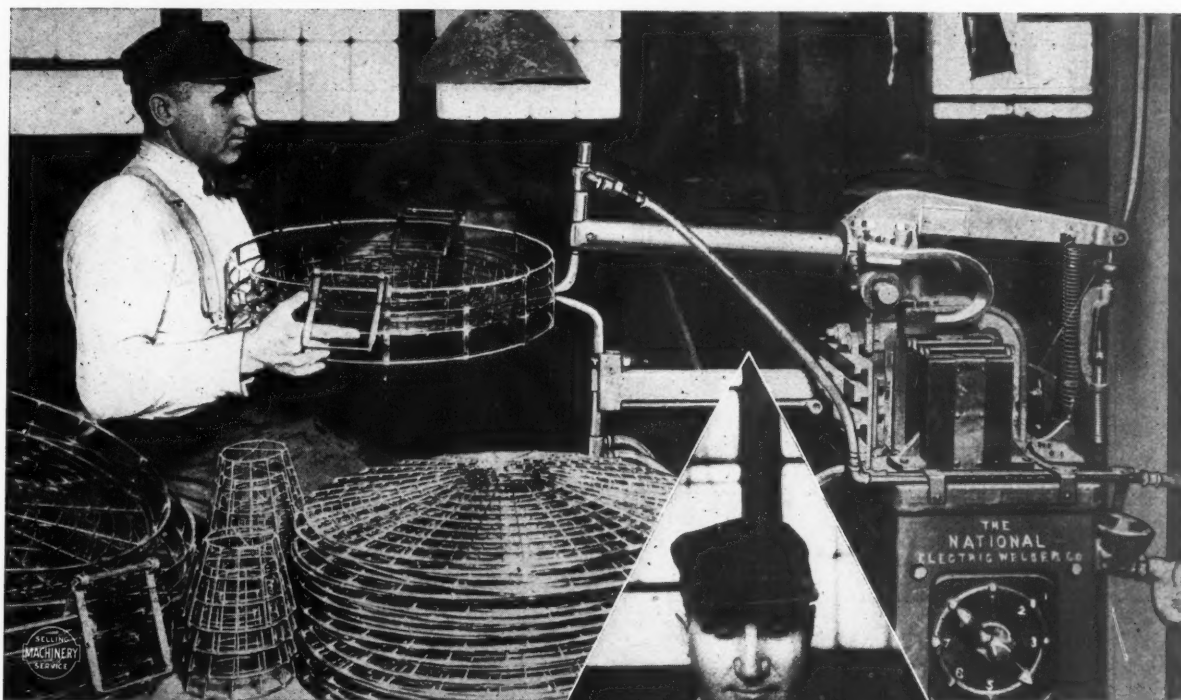
CHICAGO

MONTREAL

PHILADELPHIA

BOSTON

ESTABLISHED 1837



~~National~~ Welding PAYS "BIG" IN THIS SHOP

Pays big returns because it bettered the *quality* of the work as well as increased the *quantity* of it.

The piece is a wire basket for use in a dish-washing machine — 834 spot welds in all being made in the several baskets that go into one machine.

Walker Bros. Company, Syracuse, N. Y., reduced the time on this one particular job from eight hours to seven hours and bettered the quality of their product beyond comparison—with a ~~National~~ Electric Welder. The time to make one weld is about one second—quicker than it takes to tell about it.

This ~~National~~ has been in use over three years. It is a highly satisfactory installation from every point of view. We have the Walker Company's statement that it is indispensable for their work.

~~National~~ Electric Welders pay big returns wherever they are used. They better both quality and quantity. Let us tell you more about them.

The ~~National~~ Electric Welder Company

WARREN, OHIO, U. S. A.

Manufacturers of All Types of Spot, Butt, Jump and Seam Welders, Electric Welders and Rollers for Safe Ending Locomotive Boiler Tubes



The airplane has reached a point in its development where it becomes, in the opinions of men who should know, the greatest single factor in the greatest war ever fought. It is confidently expected to prove the deciding factor. It is already known as the "Eyes of the Army" without which that army is almost helpless.

Airplane
Manufacture

GREENFIELD TAP &
GREENFIELD



It is easy to moralize—to draw a lesson from this event or that—after it is all over. One lesson we learned quickly from the world war, however—the absolute necessity for accuracy in manufacture. It got to the manufacturers in this country fast. It was an expensive lesson to some—a lesson that once learned will never be forgotten.

First machinery, then shells, now ordnance and airplanes—where would we be without means and methods for duplicate manufacture?

The making of precision tools and measuring instruments is a fine art. G. T. D. Screw Cutting Tools and G. T. D. Standard Gages for both screw thread and cylindrical work have been developed to a high point of efficiency. They have helped many munitions and ordnance makers over the rough spots. They can help you. They can save money for you. They are invaluable if you make duplicate mechanical parts.

**Let us send more information
on this subject.**



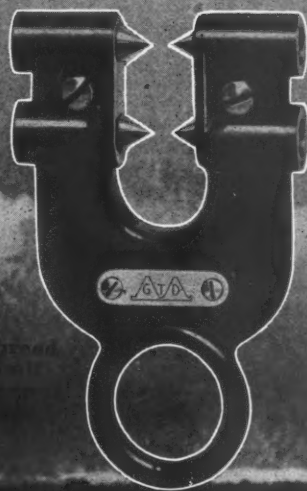
Wells
Self-Opening
Die



Acorn Die



Gun
Tap

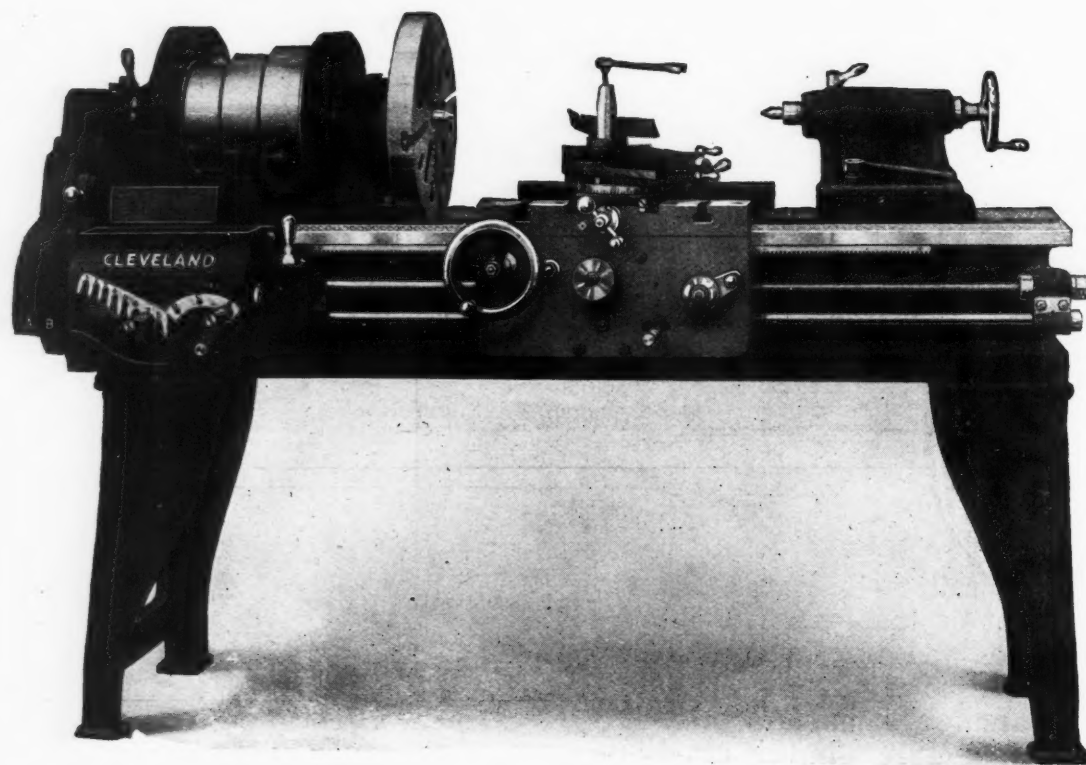


Thread
Gage

DIE CORPORATION

MASS. U. S. A.

DIVISIONS: Wells Bros. Company, Wear & Russell Mfg. Co., A. J. Smart
Mfg. Co., W. B. Wood & Son Co., Butler & Garney Co., Canadian Pattern
Wells Bros. of Canada, Ltd., Galt, Ont.



Immediate Delivery! When? Now!

A LIMITED NUMBER READY TO BOX

*Next to Workmanship and Design
is Delivery. We have them ALL*

Our lathes have margin enough to cover a large range of work. Built either as shown or with 4-step cone and single back gears. Heavy; extremely accurate; beautifully finished; all parts made to standard jigs and gauges; all interchangeable.

These lathes, owing to the large cone pulleys and wide bearings, are capable of taking extremely heavy cuts at coarse feed. We guarantee them to reduce 50 point carbon steel 1 3/4 inches at 1/16 inch feed.

*We make ball bearing drills also,
from 21" to 42". Send for Circulars*

THE CLEVELAND MACHINERY & SUPPLY CO.

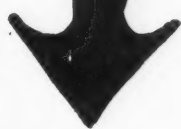
General Offices: CLEVELAND, OHIO

Factories: HAMILTON, O. COLUMBUS, O. RICHMOND, IND.

GODDARD

Milling Cutters and Hobs

Are Made Right

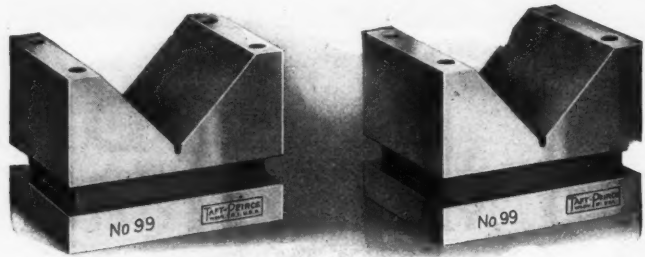


**They Give
Satisfaction**

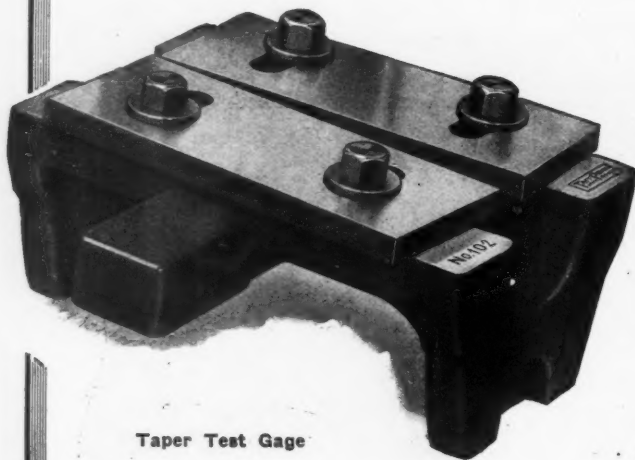
**Quick
Deliveries**

**Goddard
Tool Co.**

**Chicago, Ill.
Detroit, Mich.
U. S. A.**



Hardened Steel V-Blocks



Taper Test Gage

TAFT-PEIRCE Tool Room Specialties

In these days of shop activity, any factor or equipment which might help you keep output strictly in line with promises of delivery, should receive careful consideration. No shop aids have proved more efficient in this respect than Taft-Peirce Tool Room Specialties. If you are still making your own, the substitution of these tools will save buying extra materials, save work in your tool room, do away with congestion in tool room and the retarding of production sure to result. These specialties, manufactured in quantities and standardized, are unvarying in their accuracy.

A careful consideration of their advantages should convince you that real shop efficiency demands their adoption. Write for Catalogue B for further details.

The Taft-Peirce Mfg. Co.
WOONSOCKET RHODE ISLAND

New York, Woolworth Building
Detroit, Majestic Building



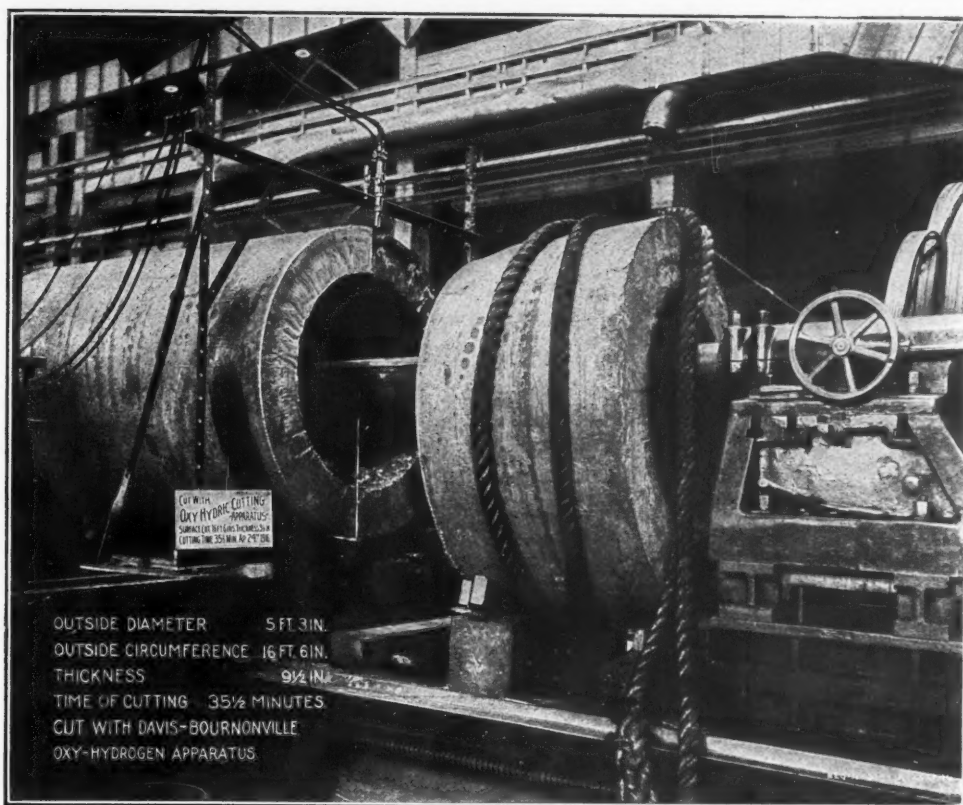
Measuring Iron No. 200



Double-end Internal Limit Gage

THESE and other
T-P small tools
are standardized
and are manufac-
tured in quantities.
You can secure du-
plicates at any time.

50,000 lbs.—5-ft.3-in.diam.—9½-in.thick How Did They Cut It in 35½ Minutes?



(Photo by New York Shipbuilding Corp.)

It was cut with a torch and gas flame—Davis-Bournonville Oxy-Hydrogen Cutting Apparatus—in the New York Shipbuilding Yards; a cast steel rotor 14½ inches thick at the head, 5 inches thick at the foot, 9½ inches thick and 5 feet 3 inches diameter where it was cut—cut slick and clean as shown in the illustration, in 35½ minutes cutting time. It would have taken many hours, and been a considerable problem, by any other method. Davis-Bournonville Oxy-Acetylene and Oxy-Hydrogen Apparatus is applied successfully to the problems in metal working, and is in use by most of the big metal working concerns—foundries, steel mills, ship yards, navy yards, locomotive and car shops, munitions plants, sheet metal working factories, etc. Make inquiry about it, or write us.

"Davis Apparatus" Leads the World in Range, Efficiency, and Number of Successful Users



DAVIS-BOURNONVILLE COMPANY
General Offices and Factory, JERSEY CITY, N. J.

NEW YORK
BOSTON
PHILADELPHIA

PITTSBURGH
CLEVELAND
CINCINNATI

← BRANCHES →

CHICAGO
DETROIT
ST. LOUIS

SEATTLE
SAN FRANCISCO
TORONTO, ONT.
(Carter Welding Co.)



AMERICAN SWISS FILES



Quality Files
for
Quality Work

FINE FILING not only requires special skill and a dexterous touch, but calls for files that are absolutely correct in shape and cut. American Swiss Files designed especially for the finer classes of work, give unqualified satisfaction and can be duplicated accurately,

There are now more American Swiss Files in use than at any time since they were first marketed.

Specify "American Swiss"

AMERICAN SWISS FILE & TOOL COMPANY

24 JOHN STREET

NEW YORK, U. S. A.

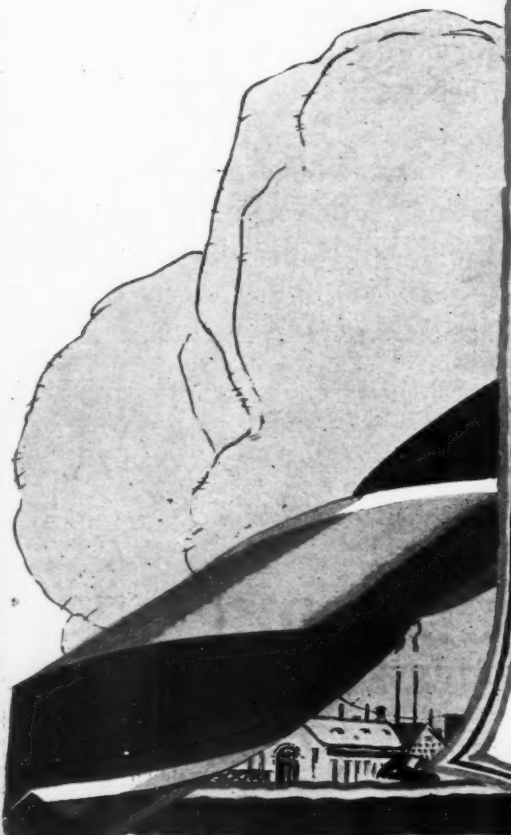
Quick Delivery Quality Tools

Large stock High Speed Steel and Carbon Steel Twist Drills, No. 60 to 3". High Speed Milling Cutters to specifications—ten days' delivery.

Tool Steel, Taps, Reamers, Tool Bits, Hack Saw Blades, Files, etc., also.

Write for Quotations

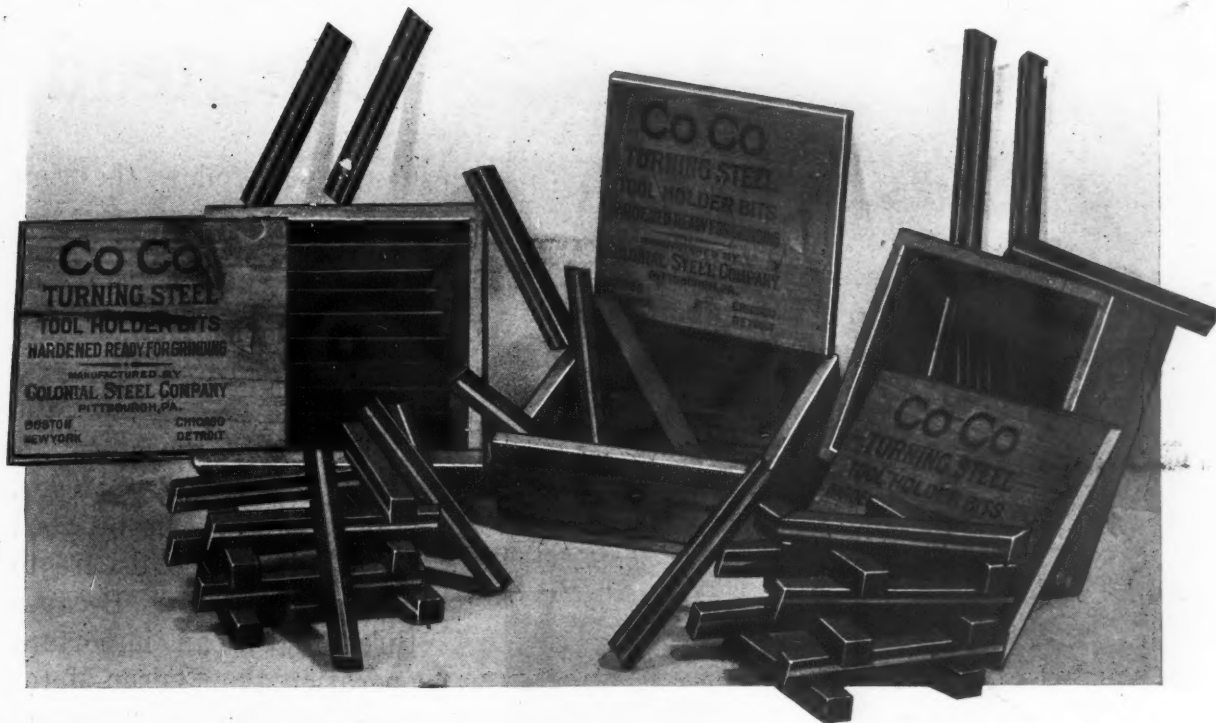
**RELIANCE
STEEL & TOOL
COMPANY INC**
30 Church Street, NEW YORK



"CoCo" TURNING STEEL

TOOL HOLDER BITS

"THE BIT WITH THE GROOVE"



What "CoCo" Is Doing On Other Jobs

"CoCo" Steel does not do stunts—It does the work. It will do yours as well. Ask us.

"CoCo" will do the same in your shop—will cut faster or longer than other steels. Here are some proofs:

"CoCo" is cutting Semi-steel Castings at 100 ft. per minute, cut $\frac{1}{2}$ " deep. 30 hours continuous service between grinds.

"CoCo" is turning Cast Iron Hydrant Caps at 169 ft. per minute, feed $\frac{1}{8}$ ", cut $\frac{3}{8}$ " and turns 4 hydrants per grind where less than one per grind used to be standard.

"CoCo" is turning .40 Carbon O. H. Forged Rams at 95 ft. per minute, feed $\frac{1}{4}$ ", cut $\frac{3}{32}$ ", turning 3 rams in the same time it formerly took to do one.

CAN YOU BEAT IT?

COLONIAL STEEL COMPANY

PITTSBURGH BOSTON DETROIT NEW YORK PHILADELPHIA ST. LOUIS CHICAGO



The "Super-Six" and the Super Die Head

Could you follow the construction of a fine mechanical creation such as the Hudson "Super-Six," you'd find up-to-date methods and the most improved tools and machines throughout the plant. Big machines or small, any device whatever, only the best can be good enough if standards are to be maintained. Because threading is an important operation, the Hudson Motor Car Co. uses the "Boehm" Die Head for that work. The photograph shows a $\frac{3}{4}$ " Die Head threading nickel steel studs ($\frac{1}{2}$ "—20 pitch—1" of threads) and giving perfect satisfaction from the standpoints of both the "big boss" and the operator. On this work a set of "Boehm"

BOEHM DIE HEAD

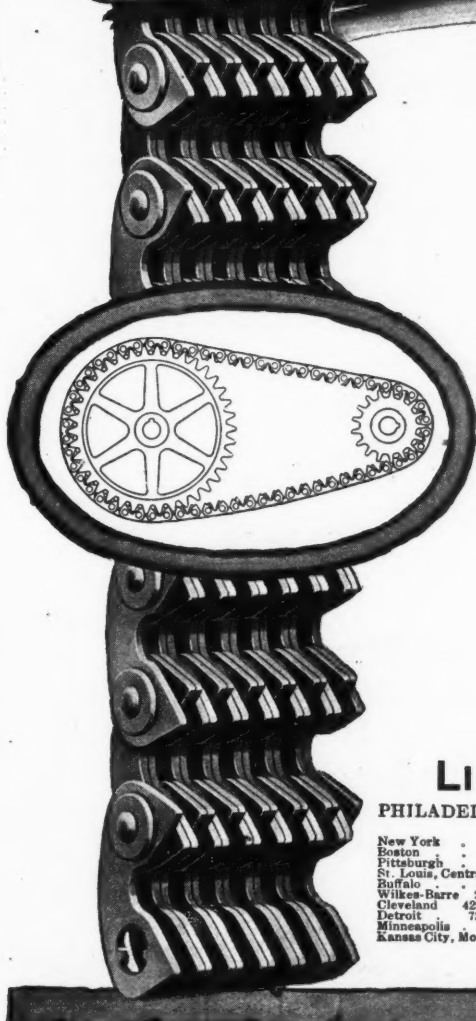
chasers averages 21,000 studs, pretty good evidence of the efficiency "Boehm" tools develop on this operation.

The "Boehm" is the only Die Head carrying a universal taper attachment cam, and it possesses the added advantage of having the triangular cam on the side of the head adjustable for any desired taper or length of thread. There are other points of superiority you should know about if you're interested in better threading and lower costs. Let us send complete description.

RICKERT-SHAFER COMPANY

612 West 12th Street

ERIE, PA., U. S. A.



POSITIVE drives insure intensive production from machine tools. Modern machines, motors, high speed steel and Link-Belt Silent Chain make continuous, rapid production a reality—assure the fulfillment of munition contracts, both as to output and character of product.

The machine illustrated was made by the Amalgamated Machinery Corporation for the Midvale Steel Company to be used for turning 296 mm. French shells. The forgings are approximately 12 inches in diameter and 44 inches long, the turning time being 19 minutes each. The 50 H. P. Link-Belt Silent Chain Drive operating the spindle is fully encased and runs in a bath of oil. Carriage drive in both directions is through a 3 H. P. Link-Belt Silent Chain Drive.

Write for Link-Belt Data Book No. 125, our 128-page pricelist.

LINK-BELT COMPANY

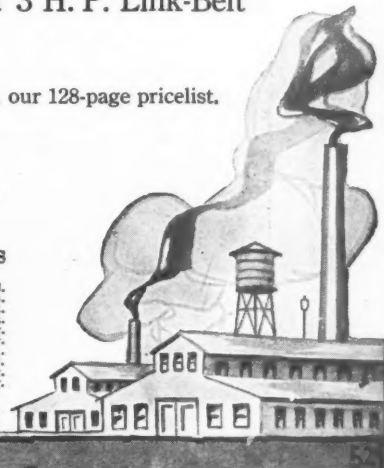
PHILADELPHIA

New York . . . 299 Broadway
Boston . . . 49 Federal St.
Pittsburgh . . . 1501 Park Bldg.
St. Louis, Central Nat'l Bank Bldg.
Buffalo . . . 698 Ellicott Square
Wilkes-Barre . . . 2d Nat'l Bank Bldg.
Cleveland . . . 429 Rockefeller Bldg.
Detroit . . . 732 Dime Bank Bldg.
Minneapolis . . . 418 S. Third St.
Kansas City, Mo., 407 Finance Bldg.
Toronto, Can.

CHICAGO

Seattle . . . 576 First Avenue, S.
Portland, Ore. . . 1st and Stark Sts.
San Francisco . . . 461 Market St.
Los Angeles . . . 161 and 163 N. Los Angeles St.
Denver . . . Lindrooth, Shubart & Co., Boston Bldg.
Louisville, Ky. . . Frederick Wehle, Starks Bldg.
Knoxville, Tenn. . . D. T. Blakey, Empire Bldg.
Birmingham . . . McCrossin & Darrah, Am. Tr. Bldg.
New Orleans . . . C. O. Hiss, Hibernia Bank Bldg.
Charlotte, N. C. . . J. S. Cothran, Com'l Bank Bldg.
Canadian Link-Belt Co., Ltd.

INDIANAPOLIS

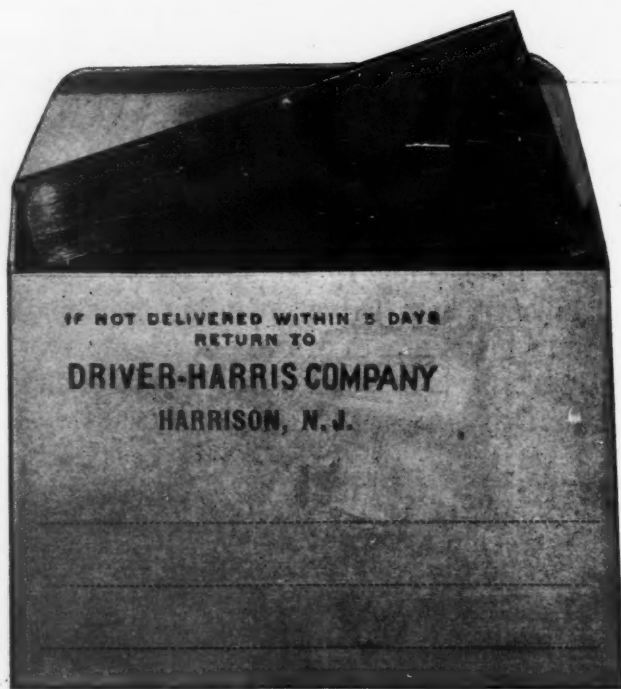


Do You Know About Nichrome

Nichrome is a nickel-iron-Chromium alloy that may be cast up to 1200 pounds. It has the properties of being hard and strong while hot, and resistance to the action of many acids. It is easily machined.

There are a thousand and one uses for Nichrome in connection with apparatus for heat-treating operations; case-hardening boxes, dipping baskets and other apparatus that require strength while hot. Particularly is Nichrome valuable for apparatus that must be alternately heated and cooled. It can be heated and cooled repeatedly without appreciable scaling.

Get this Sample of Nichrome

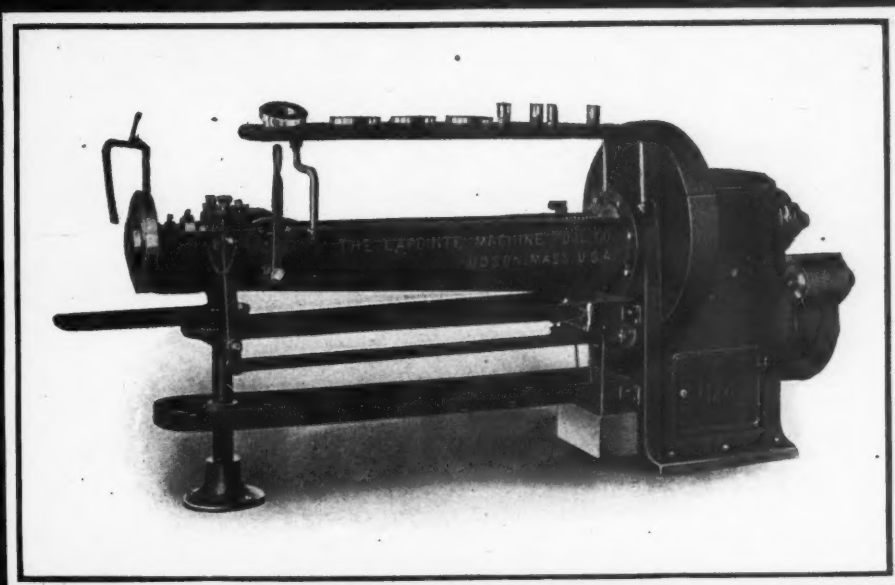


We would like to demonstrate the qualities of Nichrome to you—and have prepared a little sample which we will send for examination. It may suggest some uses in your own plant, and at any rate, we would be glad to give you all the information you desire.

Write Us

**Manufactured
under
Henderson
Patent Number
1,190,652**

DRIVER-HARRIS COMPANY
CHICAGO
28 So. JEFFERSON ST.
HARRISON, N. J.
MANCHESTER
ENGLAND



LAPOINTE Broaching Machine

Broaching clean-cut, accurate keyways, spiral grooves, square and other shaped holes usually involves skilled labor of a high order.

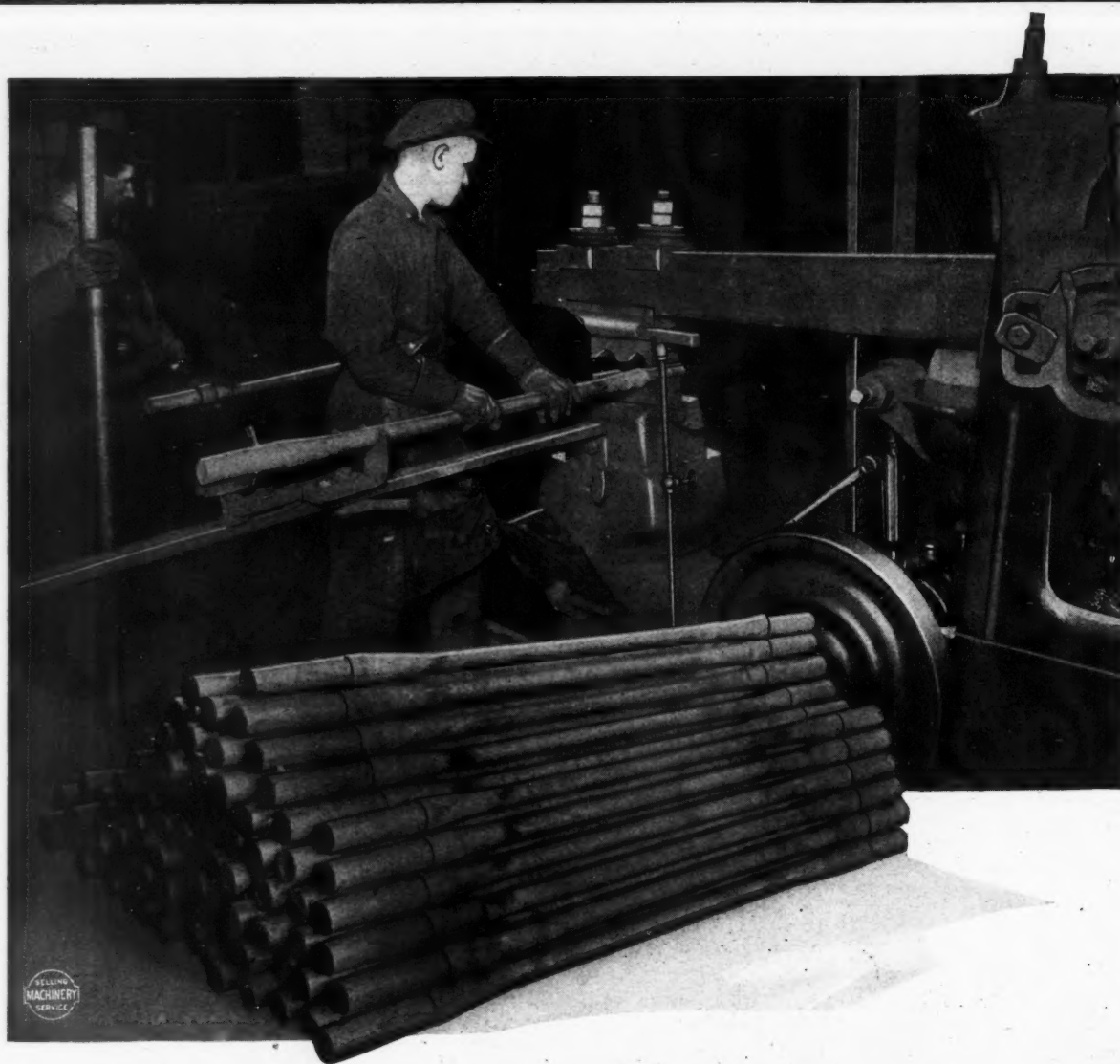
Lapointe Broaching Machines and Broaches not only take much of the responsibility for *fine* work out of the operator's hands, but put a new low mark on production costs. Why progressive companies are replacing other methods with Lapointe Broaching Machines will interest you.

Catalog gives complete information

THE LAPOINTE MACHINE TOOL CO.
HUDSON, MASSACHUSETTS, U. S. A.

DOMESTIC AGENTS: Metch & Merryweather Machinery Co., Cleveland, Detroit, Cincinnati, Pittsburgh, Henry Prentiss & Co., Inc., Buffalo, Syracuse, Rochester, New York and Boston, W. E. Shipley Machinery Co., Philadelphia, Pa., Yonsgut Machinery Co., Indianapolis, Ind., H. D. Clarke & Co., Inc., Chicago, Ill., Aumen Mch. Co., Baltimore, Md. FOREIGN AGENTS: F. G. Kretschmer & Co., Germany, Louis Beese, Paris, France, Burton, Griffiths & Co., Ltd., London, England, V. Lowener Co., Christiania, Norway, Stokvis & Fils, Brussels, Belgium, Alfred Herbert, Ltd., Yokohama, Japan, Chas. Cirita, Milano, Italy, Barandiaran Y Metivier, San Sebastian, Spain.

SEEKING
MACHINERY



One Hundred and Thirty of These Forgings Per Day on a **BRADLEY CUSHIONED HELVE HAMMER**

Could any doubter of Bradley superiority take a walk through the shop of one of the largest car building concerns in the country and watch the eighteen 80-pound Bradley Helve Hammers busy at work there, he'd *have* to change his mind. A typical job at this plant is forging bridge beam compression members. These members are first upset on a forging machine, then the hammer reduces the diameter of each end from 2½" to 2". A helper heats one end of the rod and the blacksmith does the reducing with the aid of the simple holding "rig" noted in the photograph. 260 ends are forged per day of ten hours, or 130 complete members. For over nine years Bradley speed, control, power and economy have been a source of satisfaction to this concern—and there are many others who consider it the finest machine on the market for its purpose.

The Bradley line of hammers includes Horizontal and Upright type and the Bradley "Compact." Catalogue gives full particulars—send for it.

C. C. BRADLEY & SON, Inc., SYRACUSE, N. Y.

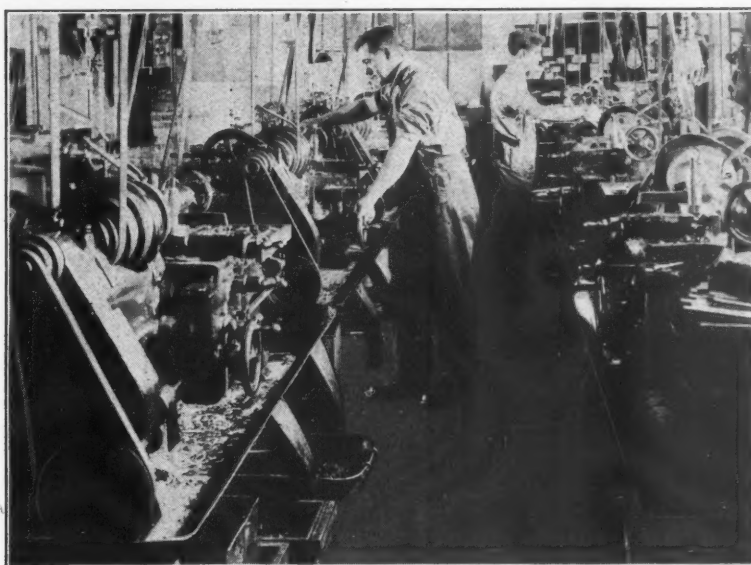
FOREIGN AGENTS: France, Belgium, Switzerland, Spain and Portugal; Fenwick Freres & Co., 8 Rue de Rocroy, Paris. Italy, Taddeo Giusti, Modena, Italy. England, Buck & Hickman, Ltd., London.

MONARCH LATHES

Give complete SATISFACTION in rapid manufacturing of duplicate parts for BUTTERFIELD & COMPANY, Tap and Die Makers at Derby Line, Vt.

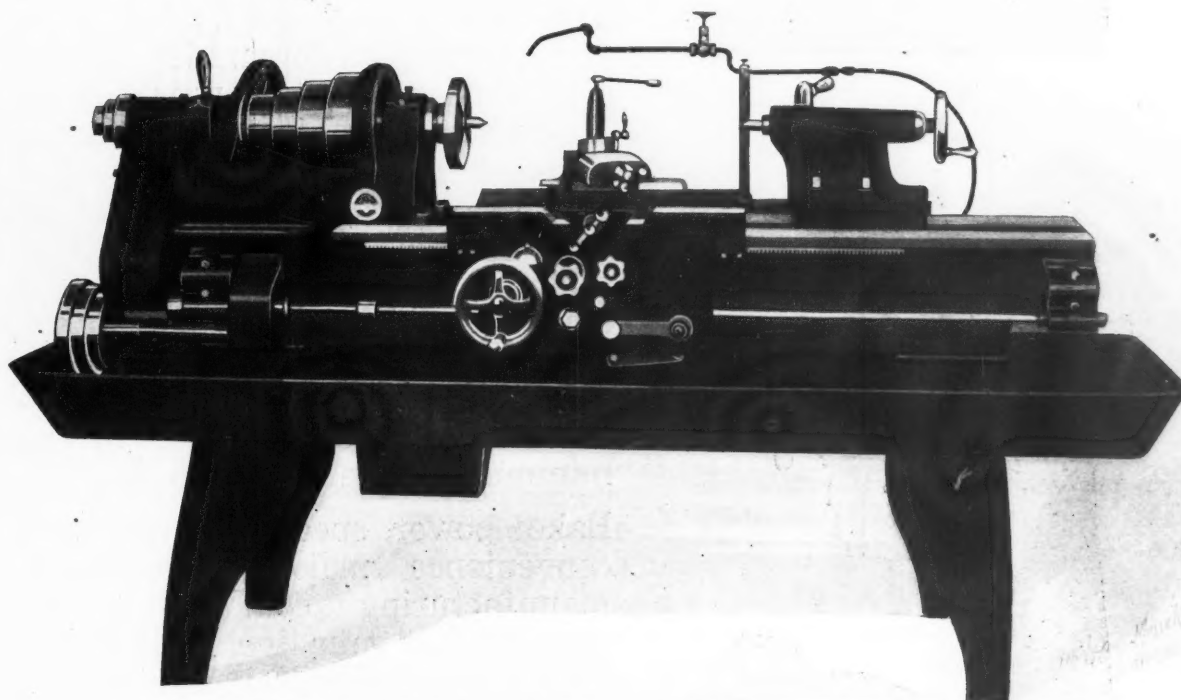
They have eight Monarch Lathes in use similar to illustration below, and they write:

"We are entirely satisfied with these eight Monarch Lathes. They are doing good work and they are satisfactory in every respect."



View showing 8 Monarch Lathes in the manufacturing department of Butterfield & Company, Tap and Die Makers, Derby Line, Vt.

Monarch Lathes are giving universal satisfaction in hundreds of such plants. Whether for manufacturing of duplicate parts or for fine tool work, there is a Monarch Lathe that we guarantee to give you satisfaction and to save you money. The prices of Monarch Lathes are reasonable. The quality is right.



14 in. x 6 ft. Monarch plain turning lathe as used by BUTTERFIELD & COMPANY for duplicate manufacturing. Equipped with pan, pump and piping, automatic length stops, taper attachment and compound rise and fall rests.

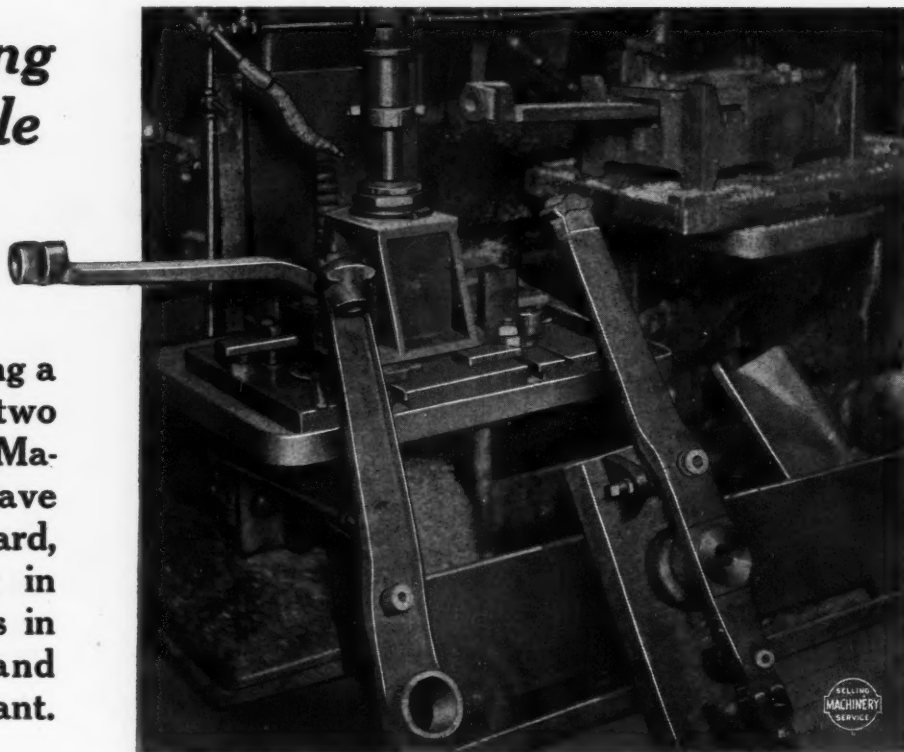
Monarch Lathes are built in all styles in 14-, 16-, 18-, 20-inch swings.

THE MONARCH MACHINE TOOL CO.
SIDNEY, OHIO, U. S. A.

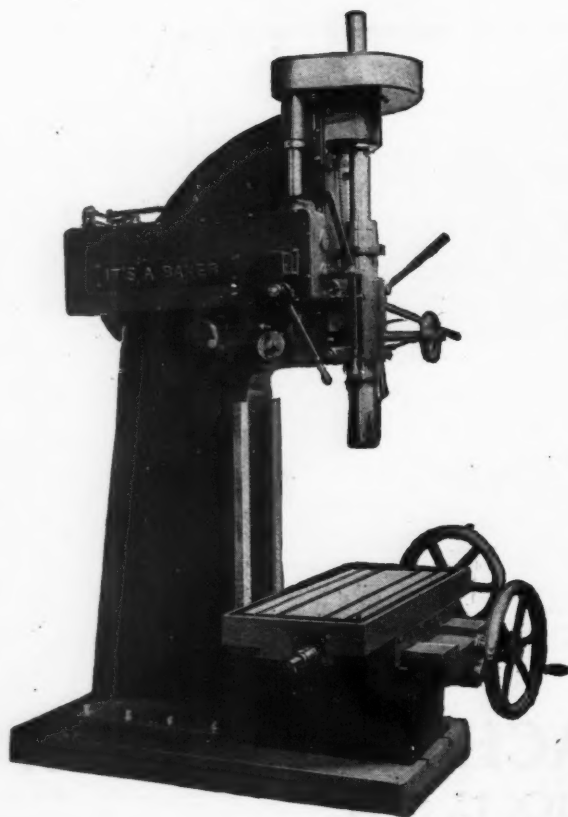
BAKER Drilling Machines

*For Making
Automobile
Parts*

We are showing a "close up" of two Baker Drilling Machines that have been doing hard, heavy drilling in steel for years in a New England automobile plant.



IT'S A BAKER



The work is cast steel distance rods. They are first rough drilled, then finish drilled, hollow milled on one side, turned, and hollow milled on the other. Nothing startling in these operations, to be sure; but they throw an interesting light on what machines used for automobile building have to stand up to as a steady job. There is a row of Baker Drilling Machines at this plant—practical, productive, dependable machines that lower costs to the minimum on the work they do.

Baker power, speed, accuracy and convenience make a profitable manufacturing combination no matter what your line. The Baker limit is the limit of what your tools can stand.

Let us work out your boring problem.

BAKER BROTHERS
TOLEDO, OHIO, U.S.A.



The
MASTER LATHE

with or without
Motor Drive

For use wherever
accurate machining
is imperative

THE Master Lathe is a high-grade, geared head tool in a 12½" swing; of solid construction, rigid throughout, and of an efficient design.

First class in every respect. Is built from the finest materials and under conditions ideal for producing a fine machine. Absolutely guaranteed as to accuracy of performance and perfection in workmanship and material.

The Master Lathe possesses many time-saving features—in addi-

tion to the recognized advantage of the geared head which transmits power to the cutting tool without belt slippage, etc.

Length of bed 4' 8½"; distance between centers, 2' 6"; speeds of head spindle (6) 28, 46, 85, 135, 225, 418.

Just now, shipment of a few Master Lathes with pulley drive can be made within ten days from the receipt of order. With motor drive attachment, within thirty days from receipt of order.

Send for particulars today

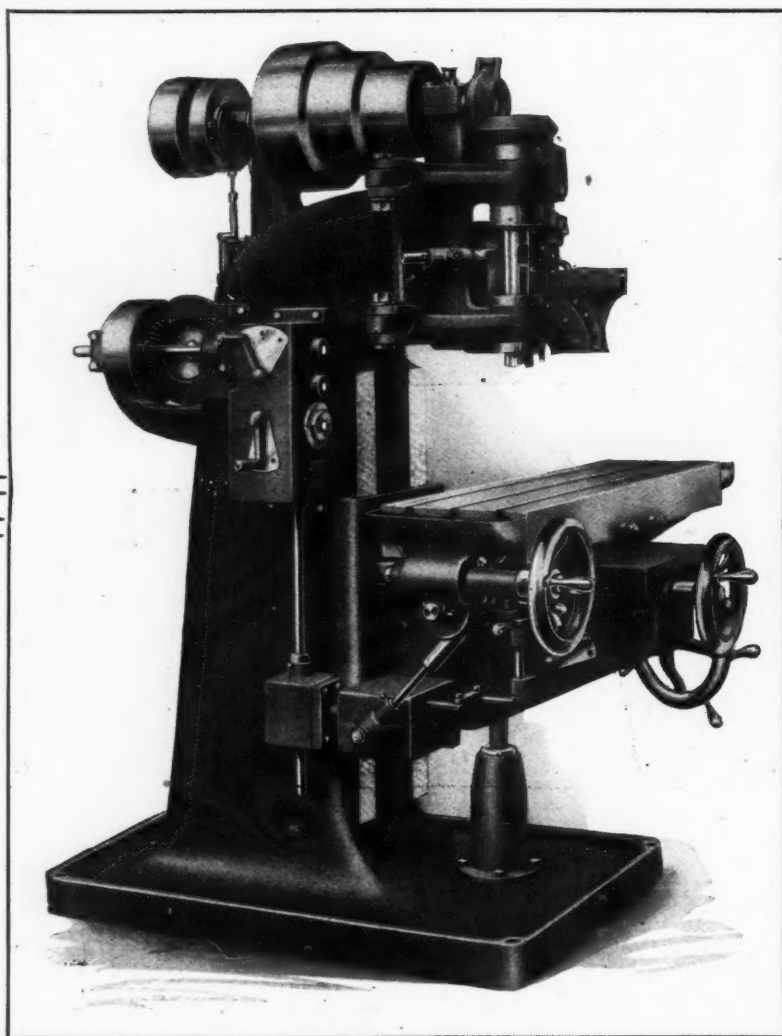
THE MASTER MACHINE TOOL COMPANY

110-112 WEST 40th STREET

NEW YORK CITY

Duplex Typeless Die Sinking Machine

Cuts Labor and Time in Making Drop Forge Dies



This shows "Duplex" No. 6—A vertical Milling Machine with additional head for cutting semi-circular impressions in drop-forge dies.

The "Duplex" will save you more money than any other machine in your Die Department.

With the "Duplex," Dies for cranks, camshafts, knuckle joints, etc., can be machined in one setting, in one-half to one-tenth the time required by typing and without the cost of types.

For prompt delivery write for Circular and Price.

JACKSON MACHINE TOOL COMPANY

Cable "Die Sinker Jackson"

JACKSON, MICHIGAN, U. S. A.

WALCOTTS

Lathes of Superior Endurance

Walcott Lathes are particularly productive in plants where machine tools are driven continually to the last notch of capacity, and on special demands even to carry an overload. To enable them to stand the pace, they are designed along lines heavier than generally followed.

Bearings and wearing surfaces are as large as practicable, much larger than usually found on lathes of corresponding sizes. Parts subject to greatest strain are reinforced, new features have been introduced and standards of design perfected. Every Walcott represents the results of 35 years of lathe building and is a wonder for high production in continuous heavy service.

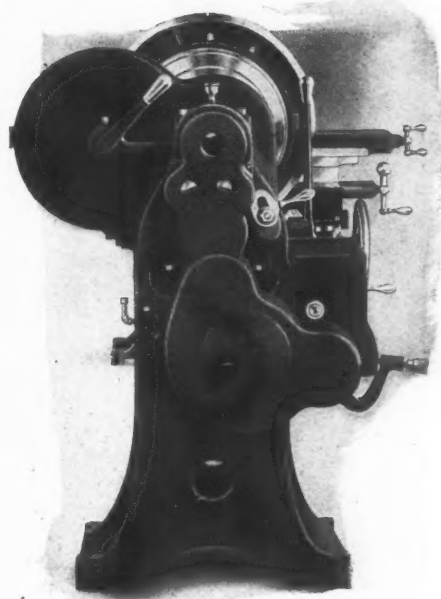
Walcotts are made in sizes from 14" to 28". Send for circulars.

Walcott Lathe Company

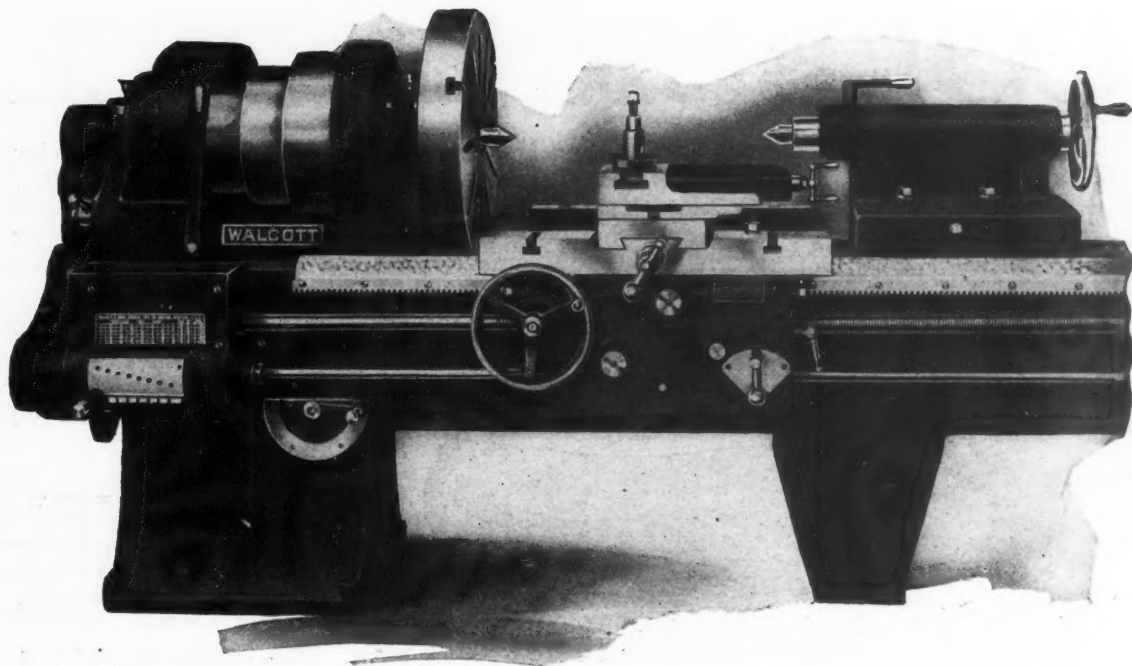
Established 1881

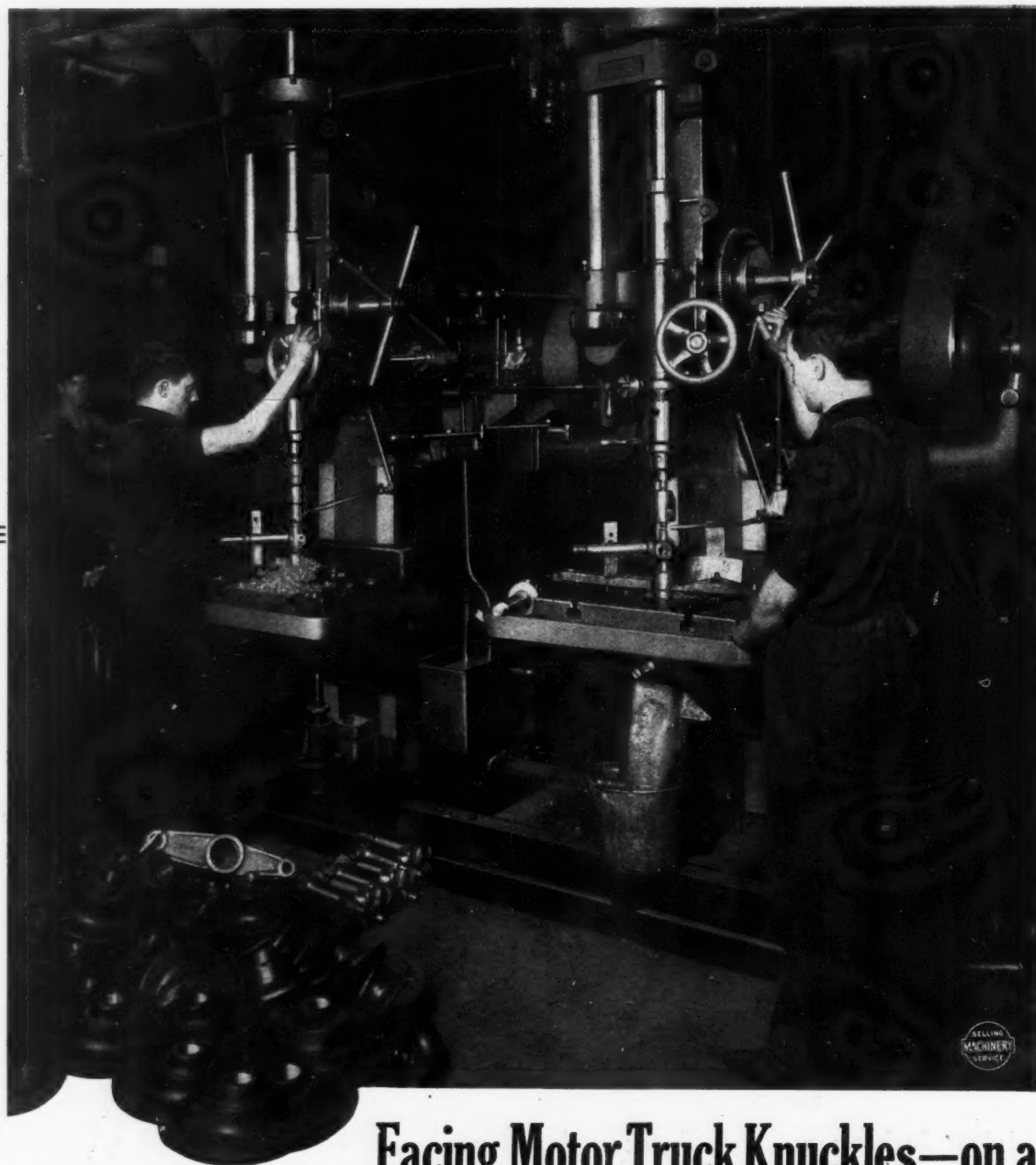
414-420 Jackson St.

Jackson, Michigan



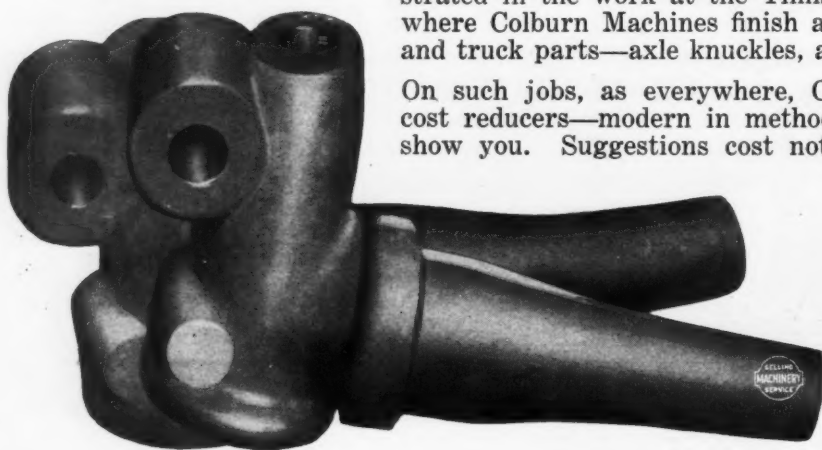
This 28" machine is typical of the line. Bed is extremely heavy; there is a large front way on the bed, a double plate apron with drop forged gears, rigid compound rest, heavy back gear arm reinforced by single-piece gear guard and headstock. Gears are enclosed, feed gears run in oil. Other features as distinctive.





Facing Motor Truck Knuckles—on a **COLBURN DRILL**

The success of Colburn Heavy Duty Drilling Machines is due not alone to their wonderful power and rigidity, though you will see them handling the heaviest work everywhere; but to their convenience and accuracy and speed on lighter kinds of work. This is demonstrated in the work at the Timken-Detroit Axle Company, where Colburn Machines finish a wide range of automobile and truck parts—axle knuckles, axles, etc.



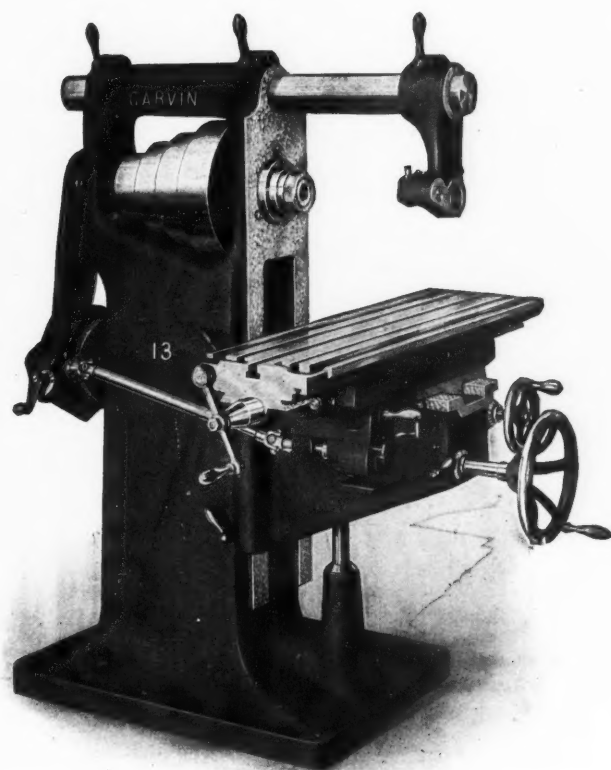
On such jobs, as everywhere, Colburn Machines are real cost reducers—modern in methods and economies. Let us show you. Suggestions cost nothing. Tell us what your problems are and we'll do the rest.

**COLBURN
MACHINE
TOOL CO.**
Franklin, Pa., U.S.A.

GARVIN

MILLING MACHINES

Made to Stand Long and Hard Usage



GARVIN No. 13 Plain Milling Machine
Use Code Accession

Known for their Rigidity, Simplicity, Efficiency and Maximum of Output. In the manufacture of these machines the best materials are used, hardened and ground where necessary.

Equipped with our

**SQUARE LOCKED
SOLID TOP EXTENDED KNEE**
(PATENTED)

doing away with all possibility of weakness or chattering.

Rigid and powerful under the most exacting cuts.

There are other exclusive GARVIN Features.

Adjustments of No. 13 Plain Miller	
Table Feed	24 in.
In and Out Adjustment	7 in.
Vertical Adjustment	19 in.
Weight	1725 lbs.

Ask a GARVIN User

**FOR FURTHER INFORMATION } ASK YOUR DEALER OR
WRITE US DIRECT**

MANUFACTURED BY

THE GARVIN MACHINE CO.

Spring and Varick Streets

50 Years in NEW YORK CITY

VISITORS WELCOME



You Can Get Small **RI** Form C Single Phase **Motors** from Stock

Remember this when you plan motor drives for small shops. Arrange the layout for individual drives— $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ H.P.—and get a stock shipment of **RI** Form C Single Phase **Motors**

Don't wait for the lineshafts, pulleys, etc., necessary for a group drive. Just pick up one of these little RI Motors, install it on the floor beside the machine and have the outfit running—all in the same day.

These fractional RI Motors have all the good mechanical and electrical characteristics of their bigger brothers (the line runs up to 20 H.P.).

The direction of rotation of RI Motors can be easily changed by loosening a screw and moving the brush rigging—or if reversible service is wanted a four pole switch is all that is required.

Ask our nearest office about stock shipments on the RI Motors in the $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$ H.P. 1800 R.P.M. sizes.

General Electric Company

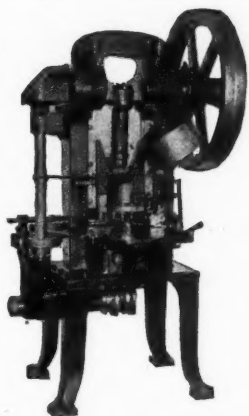
General Office:
Schenectady, N. Y.



Sales offices in all
large cities

CARTRIDGE MACHINERY

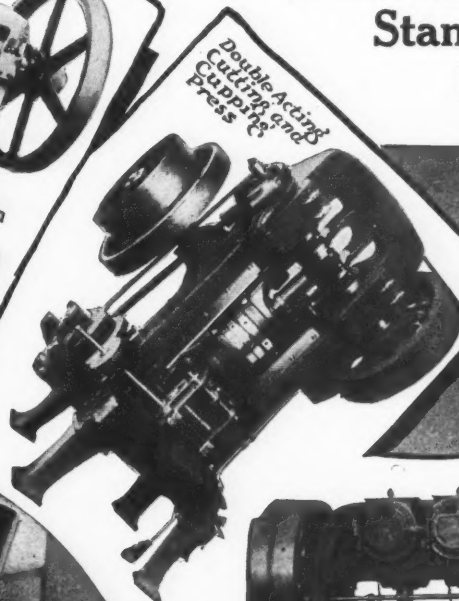
Waterbury Farrel
Standard
Machines



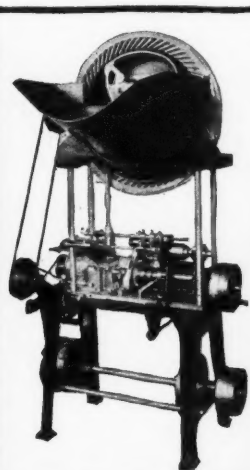
*Ratchet Dial
Bullet Assembling
Machine*



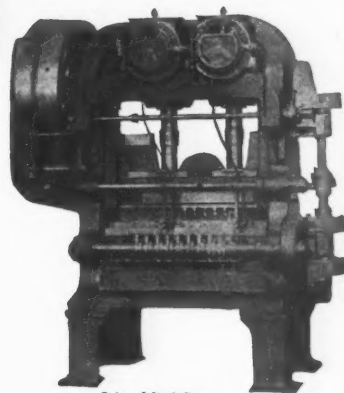
*Double Friction Dial
Double Punch Press*



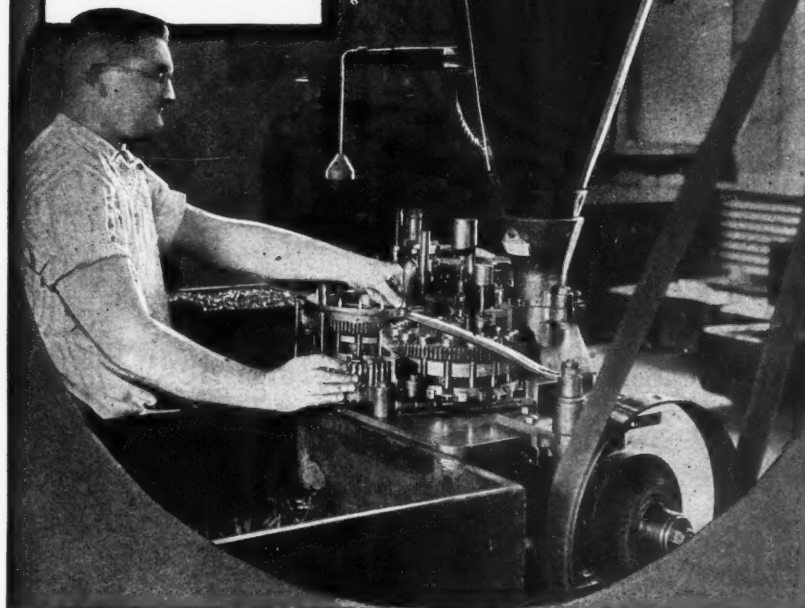
*Double Acting
Cutting and
Cupping
Press*



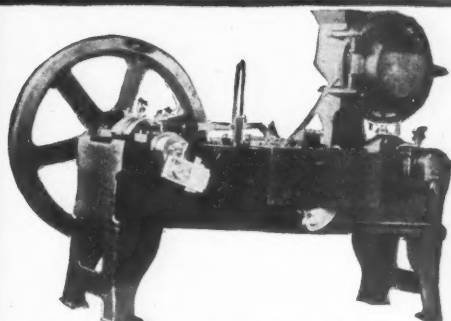
Shell End Trimmer



*Straight Line
Bullet
Assembling Machine*



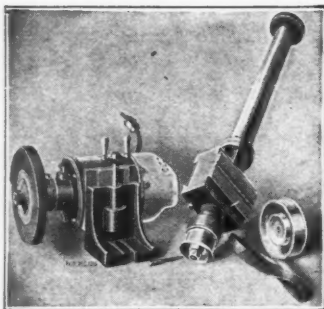
Standard Loading Machine in Government Arsenal



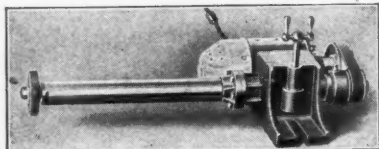
Horizontal Header Hopper Feed

The Waterbury Farrel Foundry & Machine Co., of Waterbury, Conn., U. S. A., has appointed me to be the sole manufacturer for export of their entire line of Cartridge and Shot Shell-Making Machinery. Proposals and Estimates covering complete plants or separate units required for export will be furnished on request.

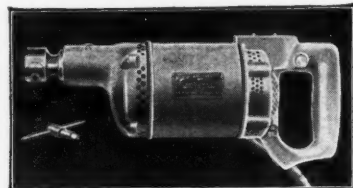
FREDERICK S. BLACKALL
WOOLWORTH TOWER NEW YORK, U. S. A.



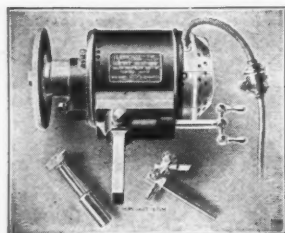
Combination Grinder with extension removed and Angle Plate fitted for external work



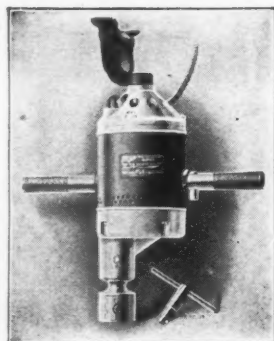
Combination Internal and External Grinder. Two sizes, $\frac{1}{4}$ and $\frac{1}{2}$ H.P.



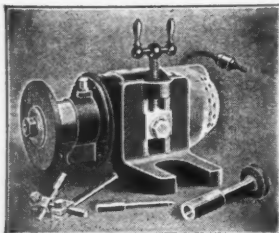
Hand Drill. Eight styles and speeds



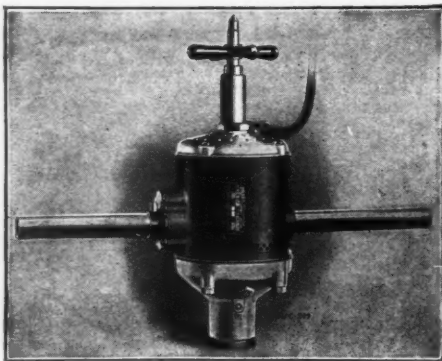
Tool Post Grinder. Ten styles and sizes



Hand and Breast Drill. Twelve styles and sizes, $\frac{1}{4}$ - to $\frac{1}{2}$ -inch capacity



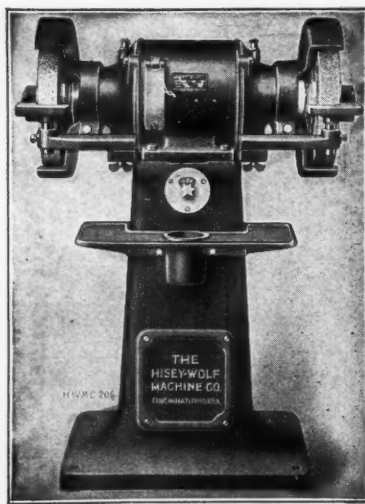
Angle Plate Grinder. Five sizes, $\frac{1}{4}$ to 3 H.P.



Heavy Duty Drill. Seven sizes, $\frac{1}{2}$ - to $2\frac{1}{2}$ -inch capacity

HISEY

Electric Machine Tools



Ball Bearing Floor Grinder. Five sizes, $\frac{1}{2}$ to 5 H.P.

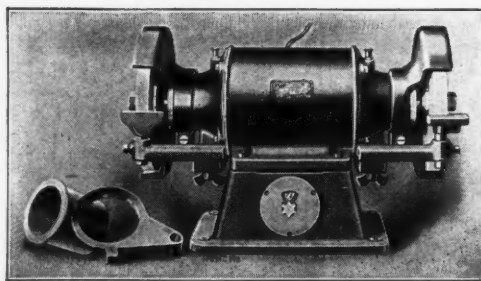
Most Complete Line of Hand and Breast Drills, Radial Drills, Sensitive Bench Drills, Portable Hand Grinders, Buffers, Bench and Pedestal Grinders, Beveling and Glass Blocking Machines.

Complete catalog No. 12 on request.

The Hisey-Wolf Machine Co.

**CINCINNATI,
OHIO, U.S.A.**

**New York
Office:
50 Church
Street**



Ball Bearing Bench Grinder. Four sizes, $\frac{1}{2}$ to 3 H.P.

RELIANCE MOTOR



"Just the Ticket" for a Bolt-Threading Machine

This is the word of the operator who runs this double-spindle Acme Bolt Threading Machine in one of the best equipped street-railway shops in the Middle West.

To keep his daily output at top notch it is necessary to have a dependable drive giving plenty of power at the right speed for all sizes of bolts. This 5 H.P. Type AS Reliance Adjustable Speed Motor gives just the results he wants.

Type AS Motors run at any speed and develop full power over ranges as great as 1 to 10. They make machine tools turn out more work.

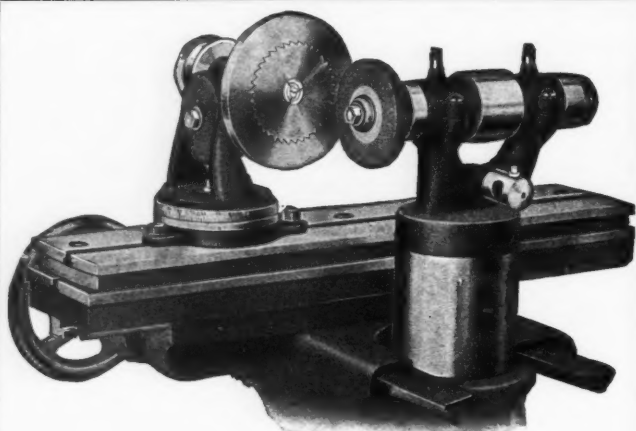
Get Our Folder 10M for Details

**Reliance Electric
& Engineering Co.**

1056 IVANHOE ROAD
CLEVELAND, OHIO

Branches: New York, Philadelphia, Pittsburgh,
Toledo, Chicago





Greenfield

Trade Mark Reg. U. S. Pat. Office

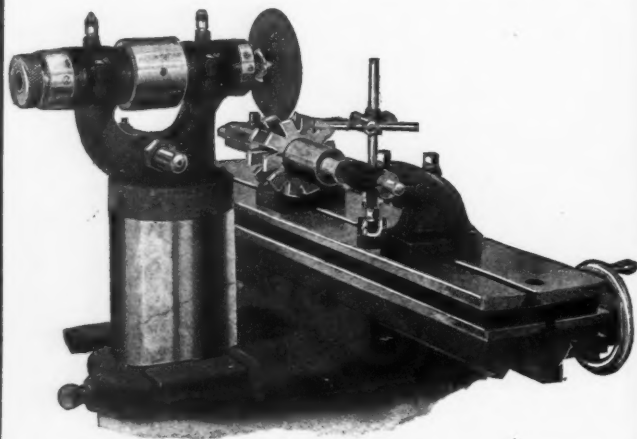
Universal Grinder

We know of no tool room or general grinding job—surface, cylindrical, internal—within the capacity of a machine of this size that the Greenfield Grinder cannot handle easily and efficiently. We have made the "Greenfield" a rigid, accurate, smooth running machine, and supply as regular equipment attachments which make it a truly universal grinder. Changes from one job to another are quickly made; controlling wheels are directly in front of operator no matter what the set-up. The Greenfield Grinder is conceded by experienced operators to be one of the most practical and economical all-around grinders on the market.

Write for the catalog.

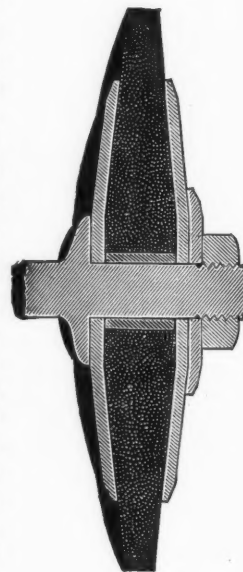
**THE GREENFIELD
MACHINE COMPANY**

GREENFIELD, MASS., U. S. A.



Safety First and Always

There can be no grinding wheel accidents in the shop equipped with Safety Grinding Wheels and Safety Collars. These wheels are tested at the factory at speeds 50 per cent higher than actual practice demands, and they're held in the collars with such a bulldog grip that pieces couldn't possibly fly, even though the unusual happened, and a wheel did break. They are perfectly safe at maximum speed. You owe it to your workmen to make your shop safe; you owe it to yourself as a sound business investment.



*Full Line of Wheels, Grinding Machines
and Grinding Room Equipment in Catalog.*

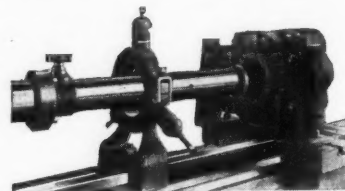
THE SAFETY EMERY WHEEL COMPANY
SPRINGFIELD, OHIO, U. S. A.

FOREIGN REPRESENTATIVES: Farmer & Co., London. Adler & Eisenschitz, Milan. Allied Machinery Co. of America, Paris.

Perfection Cylinder Grinder

Strong, Durable, Convenient

Designed for automobile cylinder grinding on hollow spindle lathes swinging 14" or over. Has centering device, micrometer adjustment, is easily set up and detached. Two models.



Write for Details

WOOD & SAFFORD MACHINE WORKS
GREAT FALLS MONTANA

REAL GRINDING ECONOMY

Wet and Dry Grinders are equally essential in most shops—but buying two machines seems extravagance.

Here is the solution—

**The Bridgeport Combination
Wet and Dry Grinder—**

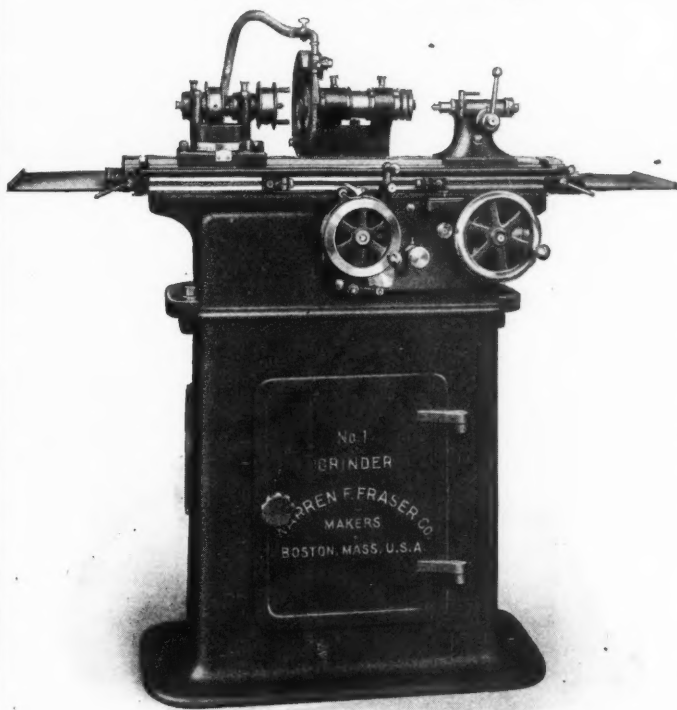
a complete Wet Tool Grinder at one end—a Dry Grinder at the other—does the work of two machines—costs little more than one. 3 sizes—belt or motor driven. See our exhibit at Foundrymen's Convention, Boston, September 25th to 28th, 1917, Booth No. 273, Section C.

**The Bridgeport Safety
Emery Wheel Co., Inc.**
Bridgeport, Conn., U. S. A.



FRASER UNIVERSAL GRINDER

The Logical Machine for
Varied Grinding



No other similar machine offers greater speed and all-round convenience in changing from one set-up to another than the "Fraser." It's only a matter of a few minutes, after finishing an internal grinding operation, for instance, to make ready for either cylindrical or surface work.

For internal grinding, capacity is 8" outside diameter, for cylindrical grinding 8" diameter by 20" length, for surface grinding work up to 6" in width and 20" long.

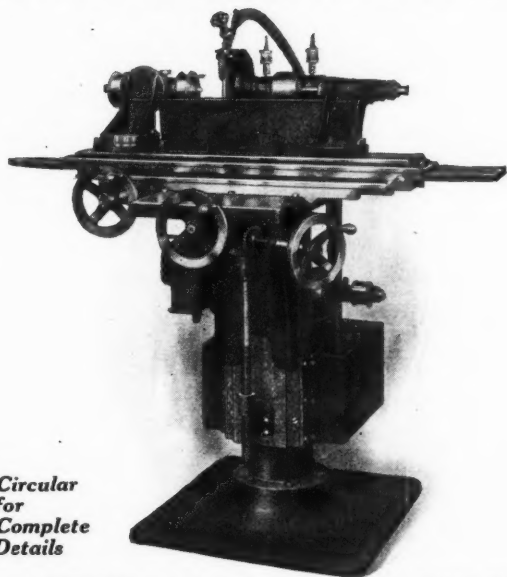
Some of the more striking features of design are: Variable table movement as low as $\frac{5}{8}$ " large bearings, double end wheel taking spindle for wheels up to $\frac{1}{2}$ " face and 8" diameter, box type base, three point suspension for upper part of machine, unit construction of apron permitting feed mechanism to be removed as a unit, two wheel speeds, four table speeds, five work rotation speeds. Let us tell you all about the possibilities of the "Fraser" for fine grinding on tools, gauges, jigs and fixtures as well as for production work within its range.

Detailed description on request.

THE WARREN F. FRASER CO.

Freeport Street BOSTON, MASS.

The Connecticut Universal Grinder



Circular
for
Complete
Details

EXTERNAL, internal, surface and cutter grinding can be handled on this machine with remarkable ease and adaptability. The unique column construction allows the table to swing in a complete circle, and with the head fastened to the column, any position is available without twisting the belt. The Universal Headstock is fitted with draw-back attachment to receive special collets for grinding small cylinders—a valuable feature for tool room work.

Middlesex Machine Works
MIDDLETOWN CONN., U. S. A.

PRODUCTION

SURFACE GRINDER



Adjustable Taper Spindle
All Surfaces Hand Scraped
Graduated Feeds

Surface of Platen 15 x 5 in.
Traverse Movement 8 in.
Vertical Movement 9 in.
Stone 6 x $\frac{1}{2}$ x $\frac{1}{2}$ in.
Speed of c/shaft 400 r. p. m.
Weight 435 lbs.

\$125⁰⁰

Write for Catalogue

NEW JERSEY MACHINERY EXCHANGE
NEWARK NEW JERSEY

This Substitute is Better than the Original

DIAMO-CARBO Emery Wheel Dressers wear longer and give more uniform service than diamond point dressers. We'll send you one on trial, to prove it, if you are willing to be convinced. Diamo-Carbo is much less expensive than diamond points—so much so that each wheel can have its own dresser.

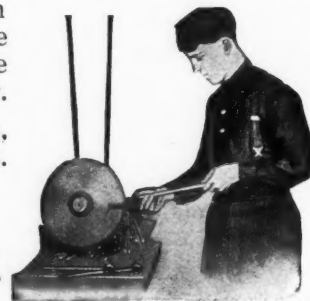
The quality is uniform, which can not be said of diamond point dressers, since the shortage of diamonds puts many inferior stones on the market. Send trial order today.



Number 3, 10 inches long.....\$3.50
Number 5, 12 inches long.....\$4.00

The
DESMOND-STEPHAN MFG. CO.
URBANA, OHIO, U. S. A.

Alfred Herbert, Ltd., Agents for Great Britain. The Canadian Desmond-Stephan Mfg. Co., Ltd., Hamilton, Ont., Distributors for Canada.



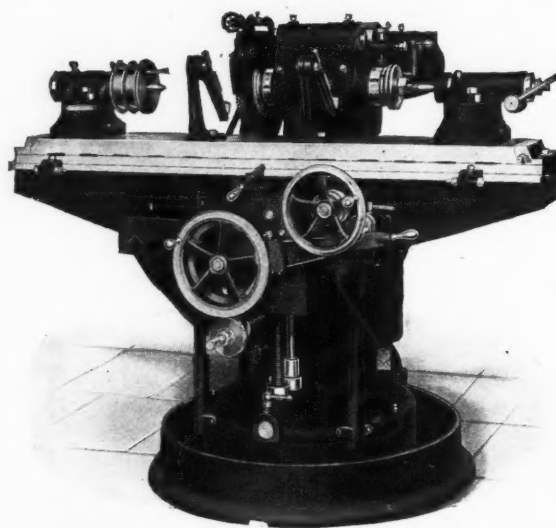
We Will Gladly Send a Copy of Catalogue Listing Our Entire Line.

The Wheel that Completes a Good Grinder

The wheel's the thing. You can "get by" with most any machine; but it's the wheel, after all, that does the work. Star Grinding Wheels complete a good machine. They are accurate, uniform in quality, long wearing—and they're needed in every shop.



STAR CORUNDUM WHEEL CO.
DETROIT MICHIGAN



A Whole Grinding Department

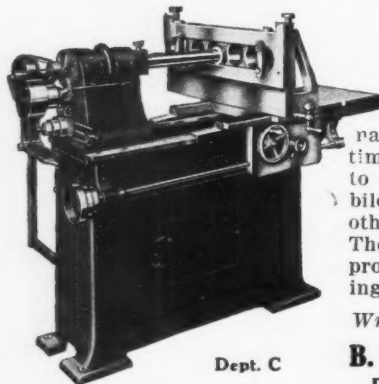
The Thompson Universal Grinder combines in a single machine means for handling every possible grinding operation within ordinary range. The head is fixed, work table being adjustable to any position to the wheel, rendering possible plain grinding, surface, edge, die, cutter and internal grinding. It's truly a universal machine with a full measure of strength, accuracy and convenience incorporated to insure high working efficiency.

Write for full particulars.

The Thompson Grinder Company
SPRINGFIELD OHIO, U. S. A.

Schmidt's Internal Grinders

Equip NOW



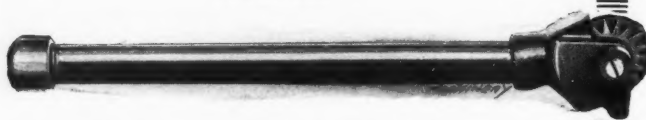
Dept. C

Here is a grinder that sells at a popular price and does the work of machines costing three times as much. Designed to grind worn automobile cylinders and do other internal grinding. There is a handsome profit in cylinder grinding.

Write for Particulars.

B. L. SCHMIDT CO.
Davenport, Iowa, U.S.A.

PATENTED



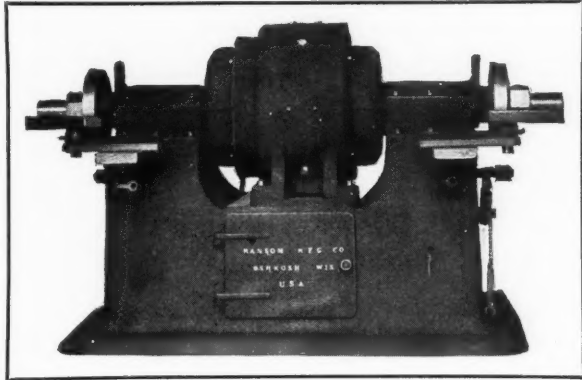
A Tryout—A Big Reorder

Invariably a trial (sometimes a skeptical one) of this improved dresser means a big reorder. The largest shops in the country recognize the superiority of the "Brandenburg" Emery Wheel Dresser, and are adopting it because the "Brandenburg" measures up to their rigid requirements.

THE "BRANDENBURG"

is a cost cutting, efficient dresser, in which the cutters are automatically lubricated by flake graphite fed from the hollow handle. Greatly saves the cutters and eliminates the cost of lubrication. Standard cutters are used. Let us help you cut costs.

THE HETHERINGTON-McCABE CO.
PIQUA, OHIO, U. S. A.



Above cut shows our No. 48 Motor Driven Grinding Machine. It is built to do the heaviest kind of grinding and especially in steel foundries.

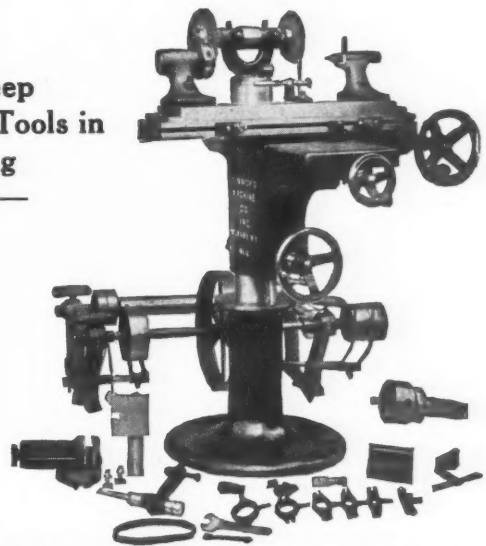
Size of wheels 24 x 4" Weight about 4000 lbs.
Size of journals 15 x 3 1/4" H. P. of motor 10

As shown above, it is equipped with Ransom Patent Speed Controller and without guards. Different types of guards can be furnished.

If interested, send for our Catalogue.

Ransom Manufacturing Co.
 OSHKOSH, WISCONSIN, U. S. A.

**To Keep
Your Tools in
Cutting
Order—**



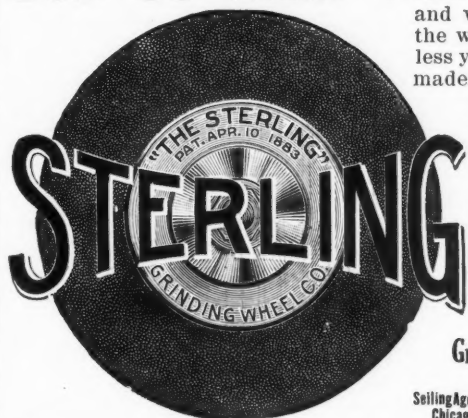
SIMMONS UNIVERSAL TOOL AND CUTTER GRINDER

You know the advantages of sharp tools; but do you know the merits of the Simmons Tool and Cutter Grinder? It not merely keeps tools sharp, but puts an *accurate* edge on them. In addition to grinding cutters, reamers, counterbores, twist drills, etc., it is adapted for cylindrical and internal grinding. The efficiency of the Simmons "Universal" includes prompt delivery service.

Write for description.

SIMMONS MACHINE COMPANY, Inc.
 987 Broadway ALBANY, N. Y. 1001 Singer Bldg. NEW YORK CITY

Tell Us What You Grind

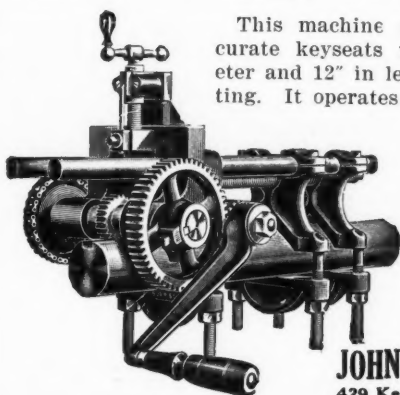


and we will tell you the wheel to use. Unless you get the wheel made for the particular grinding you do, results cannot be the best — therefore Sterling Service goes with Sterling Wheels. Catalog.

**The Sterling
Grinding Wheel Co.**
 TIFFIN, OHIO

Selling Agency: New York, 75 Barclay St.
 Chicago Store: 30 N. Clinton St.

Burr No. 1 Portable Shaft Keyseater

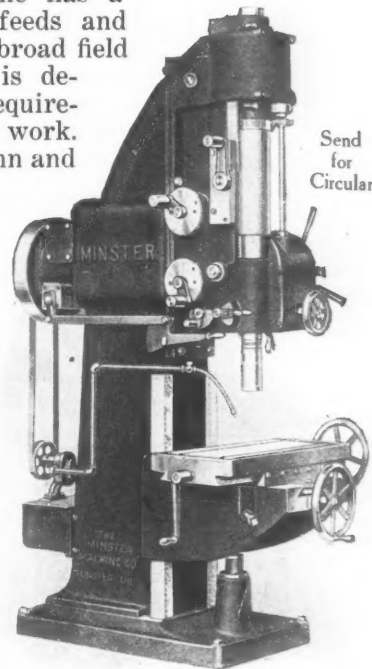


This machine cuts absolutely accurate keyseats up to 5" in diameter and 12" in length without resetting. It operates without chatter or jar, is very fast, easy to set up and remove, and can be used in practically any position. Has automatic feed and adjustable depth gauge.

JOHN T. BURR & SON
 429 Kent Ave., Brooklyn, N. Y.

THE MINSTER HI-DUTY DRILL

This new machine has a wide range of feeds and speeds, covers a broad field of drilling and is designed to meet requirements of modern work. The massive column and heavy table give ample rigidity for heavy duty; a special spindle construction provides for small high speed drilling as well as heavy work; flood lubrication of all gears, ball thrust bearings on pulley and spindle and correct balance insure smooth running. Driving pulley speed 550 R. P. M. Drills in solid steel up to 2 1/2".

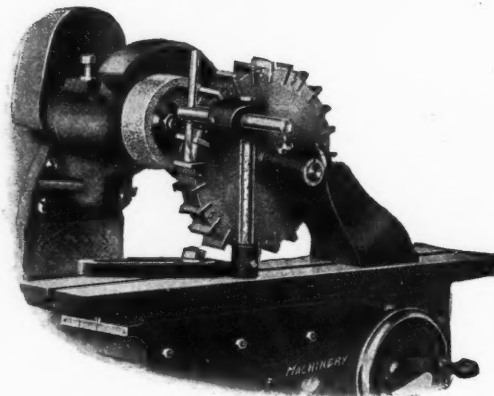
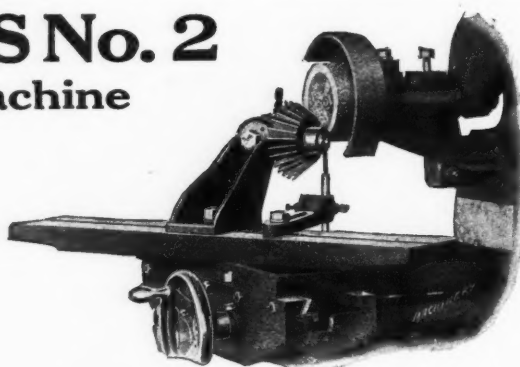
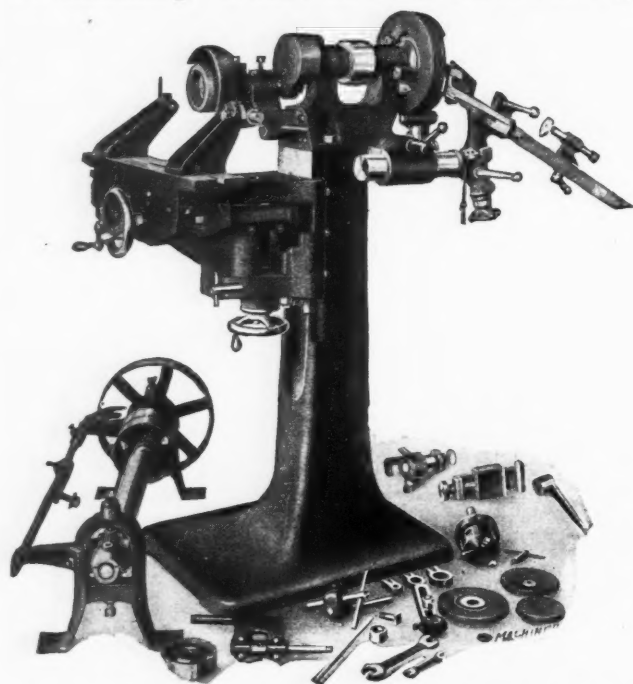


Send
for
Circular

THE MINSTER MACHINE CO.
 MINSTER! OHIO, U. S. A.

The GRAND RAPIDS No. 2

A Really Universal Grinding Machine



Not a toy—Not a makeshift—Not “The best possible for so low a price”—But **THE BEST MACHINE FOR YOUR TOOL ROOM IRRESPECTIVE OF PRICE**—And yet the price is low.

Fully illustrated circular free on request—Don't fail to ask for yours.

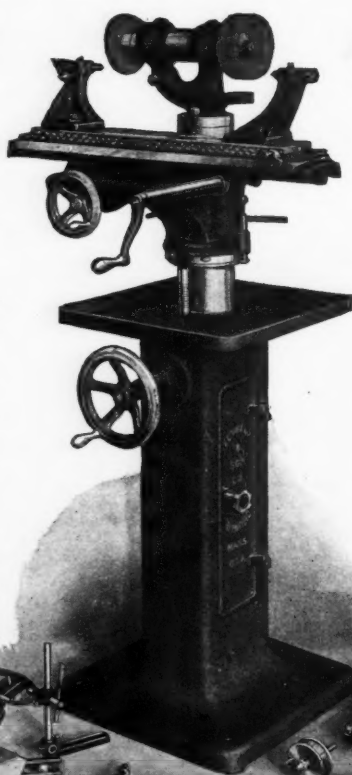
GRAND RAPIDS GRINDING MACHINE CO. 29 Ottawa Avenue, N. W.
GRAND RAPIDS, MICHIGAN, U. S. A.

A Modern Grinder at

You can grind almost anything with the Wells No. 184 Cutter and Reamer Grinder, and the Swivel Table permits grinding at any angle.

Cup wheels can be used as easily as any other as the swivel table is fitted with vertical adjustment—an advantage which no other low-priced tool grinder possesses. The table revolves entirely around the head, the slides have both horizontal and transverse movement, and the top slide swivels for taper work. All slides are hand scraped and fitted with gibs for taking up the wear. Spindle is ground, thoroughly protected by dust caps and has spring take-up for end thrust.

A rapid and dependable machine for general shop use.



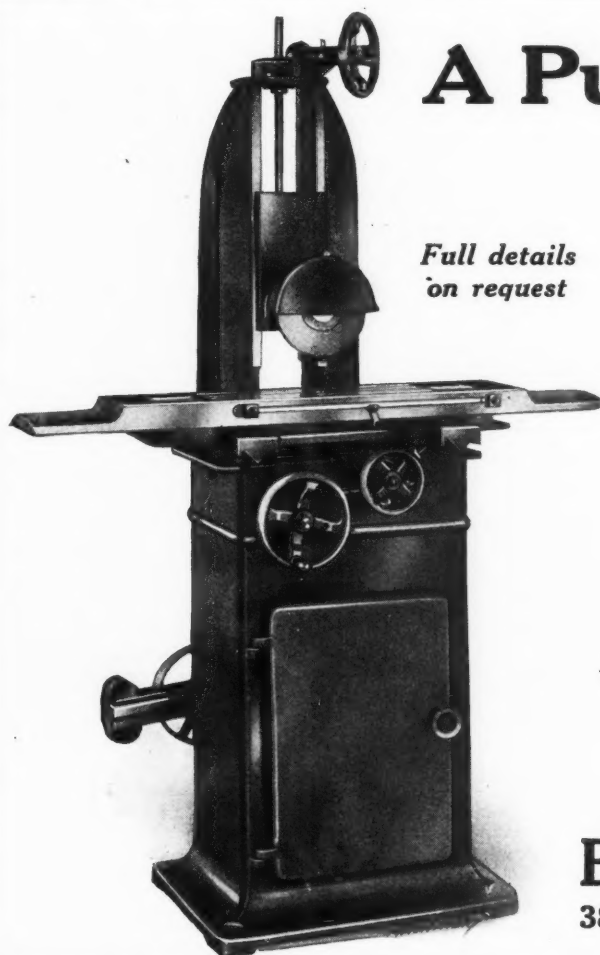
a Moderate Price

Wells Grinder No. 184



*Complete line in
Catalog 11
Send for it now—
don't wait*

F. E. WELLS & SON COMPANY, Greenfield, Mass., U.S.A.



*Full details
on request*

A Pull to Start— A Push to Stop

Simplicity is a dominant characteristic of the Reid No. 2 Surface Grinder and its influence is direct in promoting ease and convenience of operation. A *pull* on a rod operating from the center of the longitudinal feed wheel *starts* the machine, a *push* stops it. Table travel is automatic in either direction and can be reversed by dogs at the front side of the table that trip the reversing lever. Feed, which is positive, may be set to operate at end of each stroke or at the end of a complete forward and return stroke, and may be varied from 0.007" to 0.084". The machine is designed for production grinding as well as tool-room operation and will handle work up to 18" length, 6" width and 12" height. Wheel spindle takes wheels up to 7" diameter, 1/2" face and 3/4" hole.

Boston Scale & Machine Co.
381-389 Congress Street BOSTON, MASS.

Piston Rings for Hudson Cars

Piston ring production has reached such unprecedented figures that manufacturers of such parts have eagerly accepted a machine which will increase the output, remove stock quickly and hold to a limit of .0005", with a perfect finish.

Persons-Arter Grinders

are the machines which get the preference in so many shops because of their exceptional speed, accuracy, convenience and economy. You undoubtedly have work that could be handled to better advantage on Persons-Arter Grinders. Tell us what you grind—we will be glad to point out the improvement these machines will insure.

Send for catalog, too.

**THE PERSONS-ARTER
MACHINE COMPANY**
WORCESTER MASS.

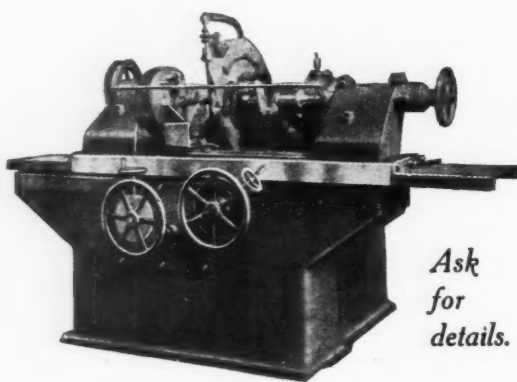


"Sterling" Grinders

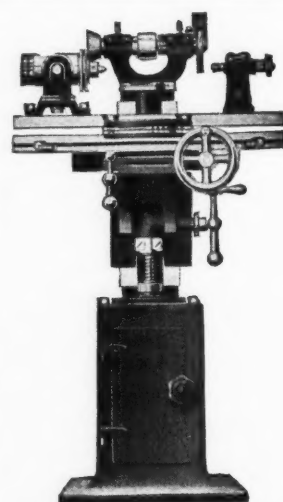
"Sterling" Grinders are well-designed, carefully built machines that can be depended upon for close accuracy and speedy production on any work within their range. They are *simple* machines—highly skilled operators are not necessary to secure best results.

Universal Tool and Reamer Grinder

Completely universal in all movements. The table revolves entirely around the head, permitting the use of the wheel at any desired angle. Gibbed slides take the travel of the knee, which revolves around a center column, and which can be locked securely in position before moving the knee. This feature is very important on work requiring close accuracy. It will pay to look into some of the possibilities of this little machine.



*Ask
for
details.*



Plain, Universal or Crankshaft Grinder

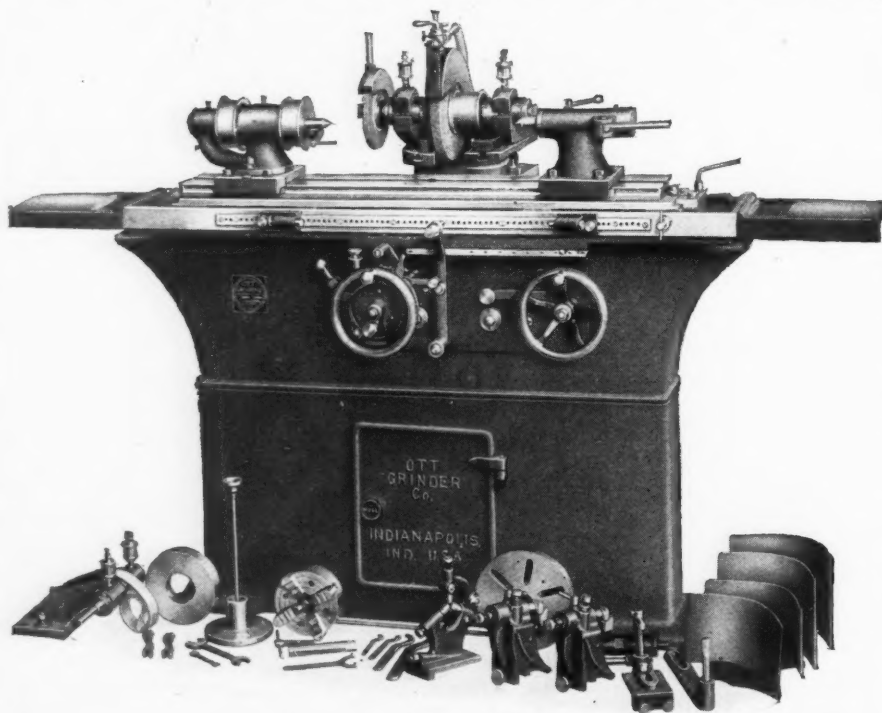
A heavy machine for manufacturing purposes; hand or power feed table; takes work up to 50 inches between centers; three point suspension is a feature, by means of which weight is carried at the same points and strains always come through the same channels; many other advantages. Prompt deliveries.

McDONOUGH MFG. CO. Machine Tool Department
EAU CLAIRE, WIS.

YOUNG, CORLEY & DOLAN, Incorporated 115 BROADWAY
NEW YORK CITY
NEW YORK AND EXPORT AGENTS

L. R. MEISENHELTER MACHINERY CO., Philadelphia, Pa.

Ott Universal Grinding Machine



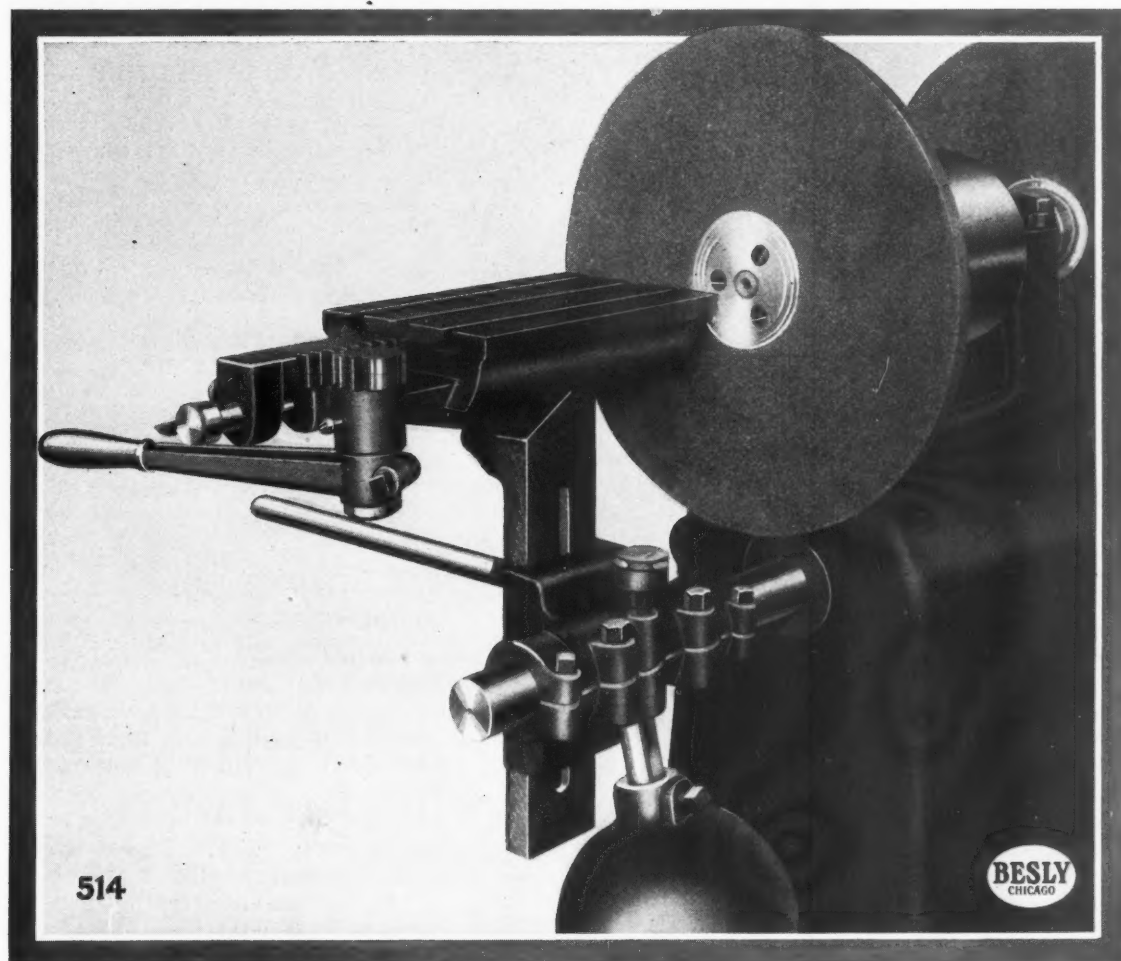
This machine supplies the need for a fast, accurate, economical grinder for universal application. Wheel arrangements for face, surface and internal grinding are ideal, the machine is exceptionally easy to control, and is strongly and rigidly constructed throughout to give a long life of continuous service. For work within a range of 9" x 26" it's the superior of many larger, higher priced machines.

*Full details should interest
you. Write.*

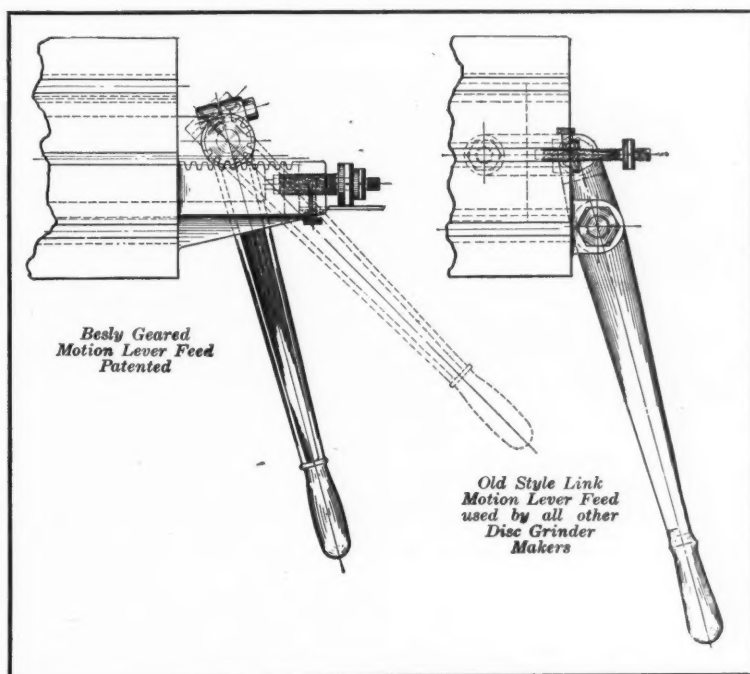
OTT GRINDER CO., Main Office and Works **Indianapolis, Ind.**

The BESLY GRINDER will do MORE WORK with LESS FATIGUE than any other disc grinder on the market

WHY? Because the Besly GEARED Lever Feed Worktable (Patented) gives three to five times greater leverage, making the work that much easier for the operator.



Rear View of Besly GEARED Lever Feed Worktable, with gear cover removed to show construction



Avoid the old style link motion lever feed with long, unhandy fixed lever and *small ratio of leverage* offered by imitators.

Insist on the Besly GEARED motion lever feed with short, handy, adjustable lever and *large ratio of leverage*.

Besly construction gives

**MAXIMUM LEVERAGE
MINIMUM FATIGUE**

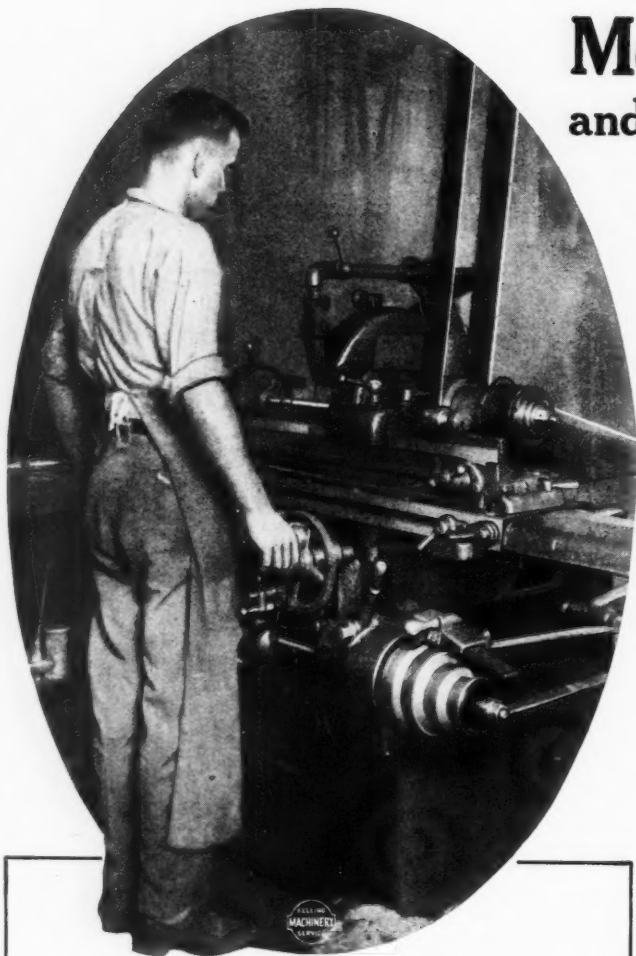
CHARLES H. BESLY & CO.

120-B North
Clinton Street



CHICAGO
U. S. A.

(Originators of Disc Grinders)



***The Norton Limit
is the
Grinding Limit***

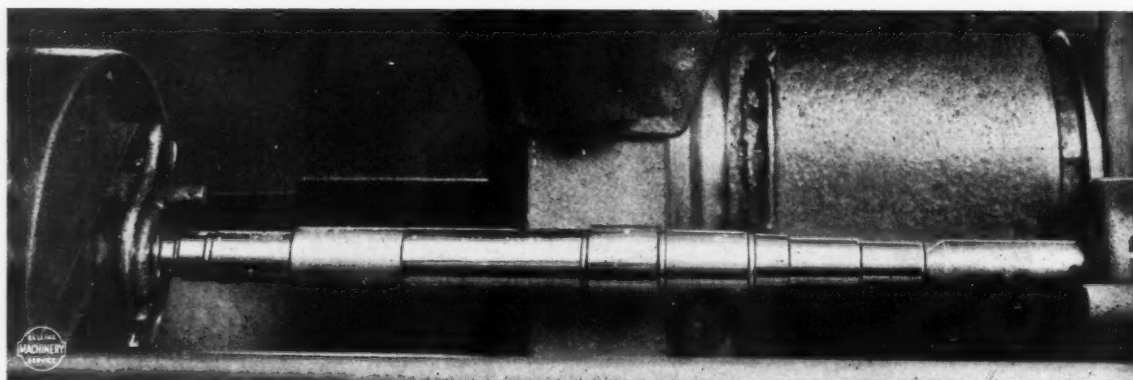
Mostly Figures— and Worth Looking Over

We are indebted to the Robbins & Myers Company, Springfield, Ohio, for facts, figures and photographs of some remarkably good grinding operations. The work is point 30 Corona Steel armature shafts 12.899" long with nine diameters to turn as follows:

1st Diameter:	0.6875"	+ 0.0005"	— 0.000"
length	0.968"	+ 0.005"	— 0.005"
2nd Diameter:	0.798"	+ 0.002"	— 0.000"
length	1.157"	+ 0.005"	— 0.005"
3rd Diameter:	0.875"	+ 0.001"	— 0.000"
length	0.625"	+ 0.005"	— 0.005"
4th Diameter:	1.001"	+ 0.000"	— 0.0005"
length	1.391"	+ 0.005"	— 0.005"
5th Diameter:	1.125"	+ 0.005"	— 0.005"
length	1.094"	+ 0.005"	— 0.005"
6th Diameter:	1.001"	+ 0.000"	— 0.0005"
length	4.703"	+ 0.005"	— 0.005"
7th Diameter:	0.8135"	+ 0.000"	— 0.0005"
length	1.312"	+ 0.005"	— 0.005"
8th Diameter:	0.7876"	+ 0.001"	— 0.000"
length	0.531"	+ 0.005"	— 0.005"
9th Diameter:	0.6595"	+ 0.0005"	— 0.000"
length	1.118"	+ 0.005"	— 0.005"

The operator grinds 50 to 60 shafts on one diameter, then dresses the wheel and grinds the next diameter until the shaft is completed, dressing the wheel between each diameter. The wheel used is a 14" x 2 1/4" Norton 24-M. Wheel speed, 5500 feet per minute; work speed 70 feet per minute. Output per 11-hour day, 110 complete shafts.

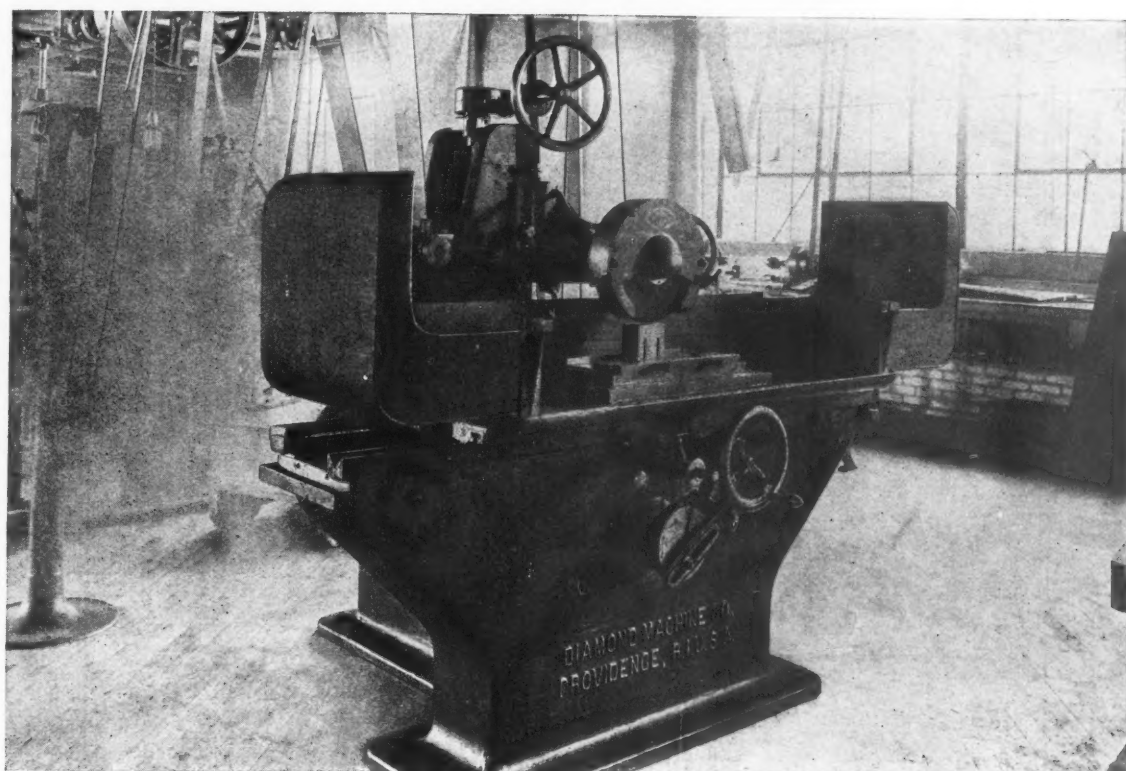
Let us tell you more about Norton Grinding—show what it can do for you.



NORTON GRINDING COMPANY, Worcester, Mass., U.S.A.

CHICAGO STORE: 11 North Jefferson Street

AGENTS: Vonnegut Machinery Co., Indianapolis, Ind. Robinson, Cary & Sands Co., St. Paul, Minn.; Duluth, Minn. Manning, Maxwell & Moore, Inc., St. Louis, Mo. Henry Prentiss & Co., Inc., New York, N. Y.; Boston, Mass., Buffalo, N. Y., Rochester, N. Y., Syracuse, N. Y., Scranton, Pa. The Motch & Merryweather Machinery Co., Cleveland, O. Detroit, Mich., Pittsburgh, Pa., Cincinnati, O. Eccles & Smith Co., San Francisco, Cal., Los Angeles, Cal., Portland, Ore. The Canadian Fairbanks-Morse Co., Montreal, Que., Toronto, Ont., Vancouver, B. C. C. T. Patterson Co., Ltd., New Orleans, La. Kemp Machinery Co., Baltimore, Md. W. E. Shipley Machinery Co., Philadelphia, Pa. Alfred Herbert, Ltd., Coventry, England, Paris, France, Milan, Italy. Post Van der Burg & Co., Rotterdam, Holland. The F. W. Horne Company, Tokio, Japan. Iznoskoff & Company, Petrograd, Moscow and Ekaterinburg, Russia. N-8



The Diamond Surface Grinder in the National Scale Works

The biggest thing in sight, in this corner of the toolroom at the National Scale Company's shops, is the Diamond Surface Grinder.

It's a big producer—" . . . a wonderful producer," they call it in a recent letter, and add that it is giving them "excellent satisfaction."

In the National's shop the "Diamond" is used principally for grinding the sides of dies, from the rough, and for re-sharpening—an average of .005 to 1/16" of stock being removed from each surface.

Such work is by no means the extent of the "Diamond" range. It gives excellent service on surfacing anything from cutlery to castings.

DIAMOND SURFACE GRINDERS
are easy to operate, accurate,
rapid and economical.

Complete Catalogue
on Request.

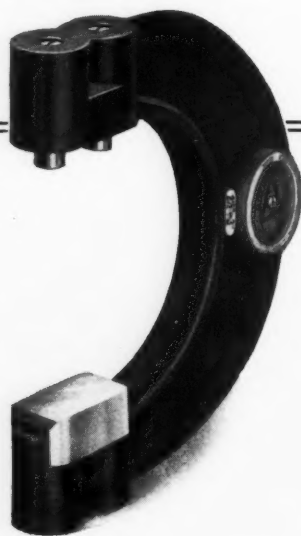
DIAMOND MACHINE COMPANY
PROVIDENCE, RHODE ISLAND



DIAMOND MACHINE CO.
PROVIDENCE, R.I. U.S.A.



**For
Accurate
Work**

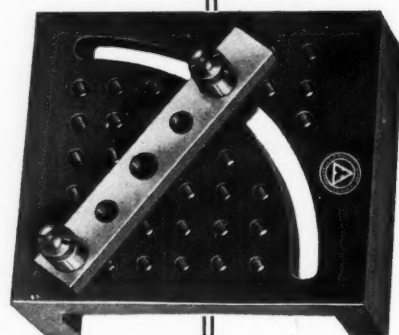
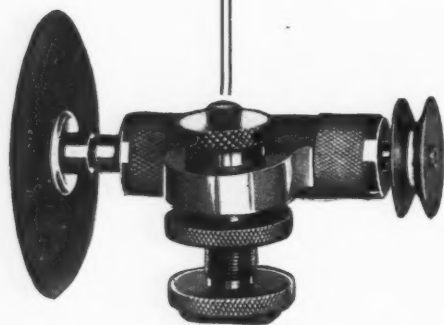


**You
Will
Need**



S.A.S. PRECISION TOOLS

**Made by Skilled
Workmen
Who Thoroughly
Appreciate
the Demand for
High Grade Tools**



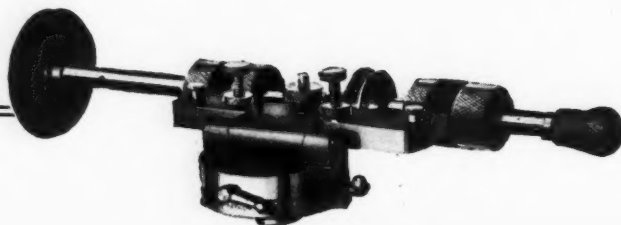
**Superior in Materials and Finish
Built for Endurance**

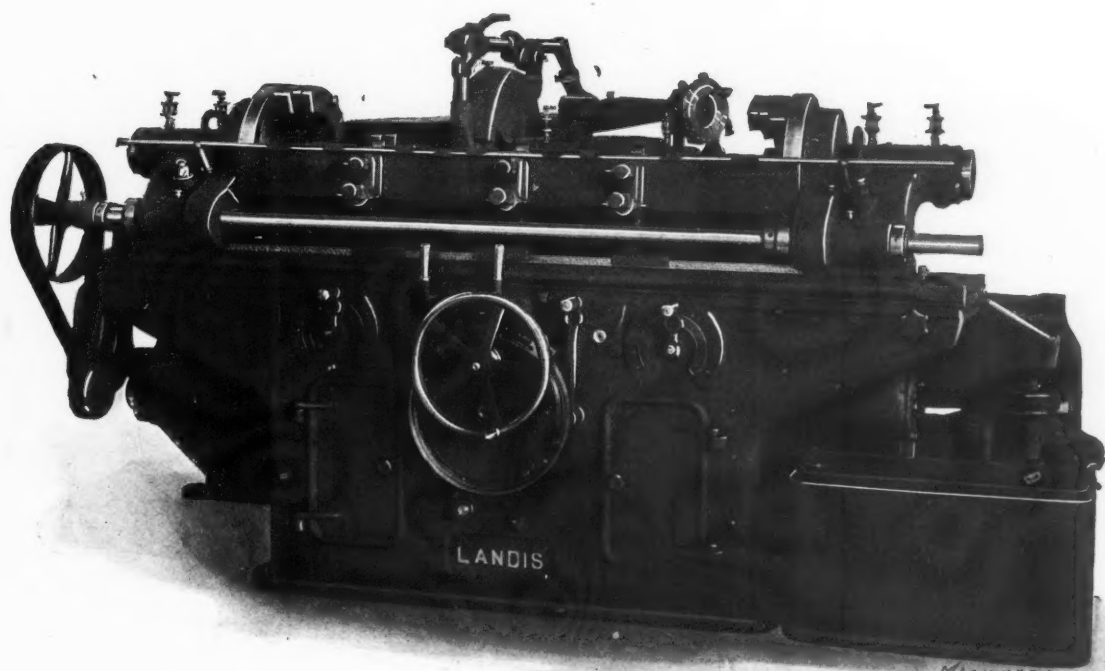
Write for Description and Prices

**SLOCUM, AVRAM & SLOCUM
LABORATORIES, Inc.**

550 West 21st Street

NEW YORK CITY



**LANDIS**

We'd like to send you the catalogue and show you just what to expect from LANDIS Grinding Machines. Send drawings along for figures—we'll be glad to prepare them. Grinding machines for all manufacturing purposes.

LANDIS TOOL COMPANY

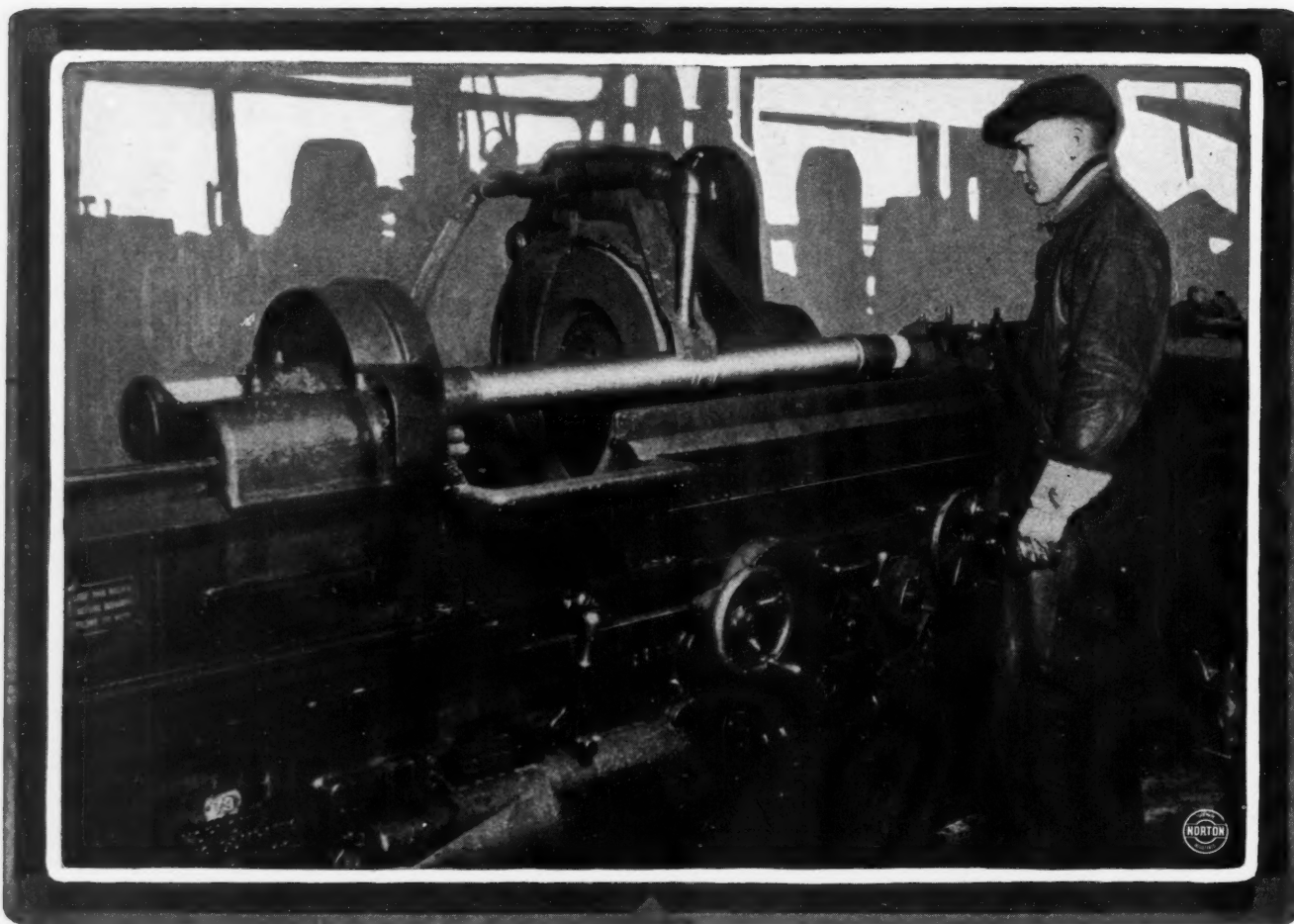
Main Office and Works
**WAYNESBORO
PA. U. S. A.**

It's Not Difficult to Secure New Business

Not when you can refer New Business to Old Business—not when the machines in use back up the claims you make for the machine you hope to sell.

And that is why it is easy to sell LANDIS Grinding Machines to men who have work for them to do. LANDIS Grinding Machines, in use all over the world, back up every claim we make for them. They are correct in design—the grinding wheel travels and the work table is stationary—production is large—accuracy is just as close as you may want to make it—finish is unsurpassed.

More weight, less floor space. More work, less wheel expense—and it is all in the design. Ask any LANDIS user.



Grinding "Big Four" Piston Rods

THIS photograph was taken in a large eastern railway shop and shows a "Big Four" piston rod being ground on a NORTON machine and with a NORTON wheel.



The wheel used is a 24 x 3 $\frac{3}{8}$ x 5", 24 combination, grade M, ALUNDUM, and is giving satisfactory results.

Under slightly different conditions a 24 combination L ALUNDUM has also proven satisfactory.

NORTON COMPANY

WORCESTER, MASS.

ELECTRIC FURNACE PLANTS

New York Store
151 Chambers St.

Chippawa, Ont., Can.
Niagara Falls, N. Y.

Chicago Store
11 N. Jefferson St.

The New YANKEE Drill Grinder

All it has cost the owner of this "New Yankee" for ten years' drill saving service is the *price of oil and grinding wheels.*

Granted a first-class drilling machine, the chief factor essential to high production is accurately ground drills. "New Yankee" accuracy is positive and uniform. The machine is so simple a wide-awake boy can run it.

**Over
Ten Years'
Service and
Not a Cent
for Repairs**

It does its work so efficiently that from 50 to 75% is saved on drill costs. There's a "New Yankee" to meet every modern drill grinding requirement. Write for catalog No. 106.

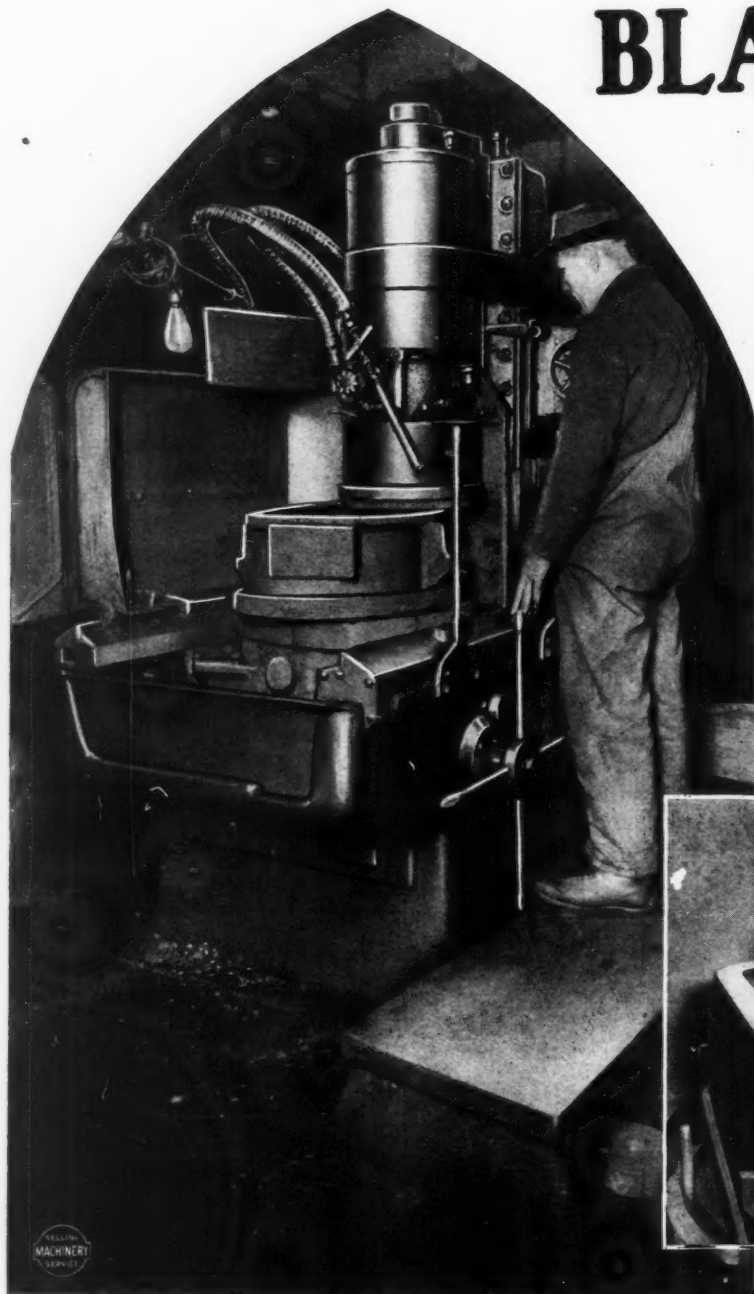
**Wilmarth &
Morman Co.**

2180 Monroe Ave., N.W.
Grand Rapids, Mich.

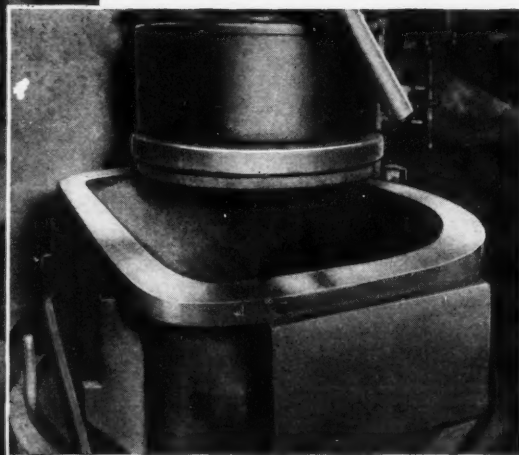
*Manufacturers of Drill
Grinders, Surface Grinders,
Universal Grinders.*



Five Years' Heavy Work for this BLANCHARD GRINDER



The Blanchard is a rapid producer. These chilled cast iron mouth pieces for retorts, for example, are faced off on one side at the Leetsdale plant of the Riter-Conley Mfg. Co., Pittsburgh, Pa., at an average of twenty minutes per piece. From each one of these mouth pieces $\frac{1}{8}$ of an inch of chilled cast iron is removed, enough to square up and clean up the surface.



The all over size of the face is approximately twenty inches by thirty inches, and the flange is one and one-half inches wide.

This Blanchard Grinder has been run by comparatively inexperienced labor since 1912, and has given excellent satisfaction. We can show you thousands of illustrations of Blanchard grinding varying from work as large as this down to the smallest of punchings from thin sheet metal, all handled efficiently and economically as well as accurately.

Let us send more details.

THE BLANCHARD MACHINE COMPANY
64 STATE STREET CAMBRIDGE, MASS., U. S. A.

DOMESTIC AGENTS: Henry Prentiss & Co., Inc., Mott & Merryweather Machinery Co., Marshall & Huschart Machinery Co., W. E. Shipley Machinery Co., Kemp Machinery Co., Robinson, Cary & Sands Co., Pacific Tool & Supply Co. CANADA: Williams & Wilson, Ltd., A. R. Williams Machinery Co., Ltd. GREAT BRITAIN: Burton, Griffiths & Co., Ltd. FRANCE: Aux Forges de Vulcain.

What is Y-O-U-R Grinding Problem?



IF you are facing a grinding problem you are facing a need for **AMERICAN GRINDING WHEELS.**

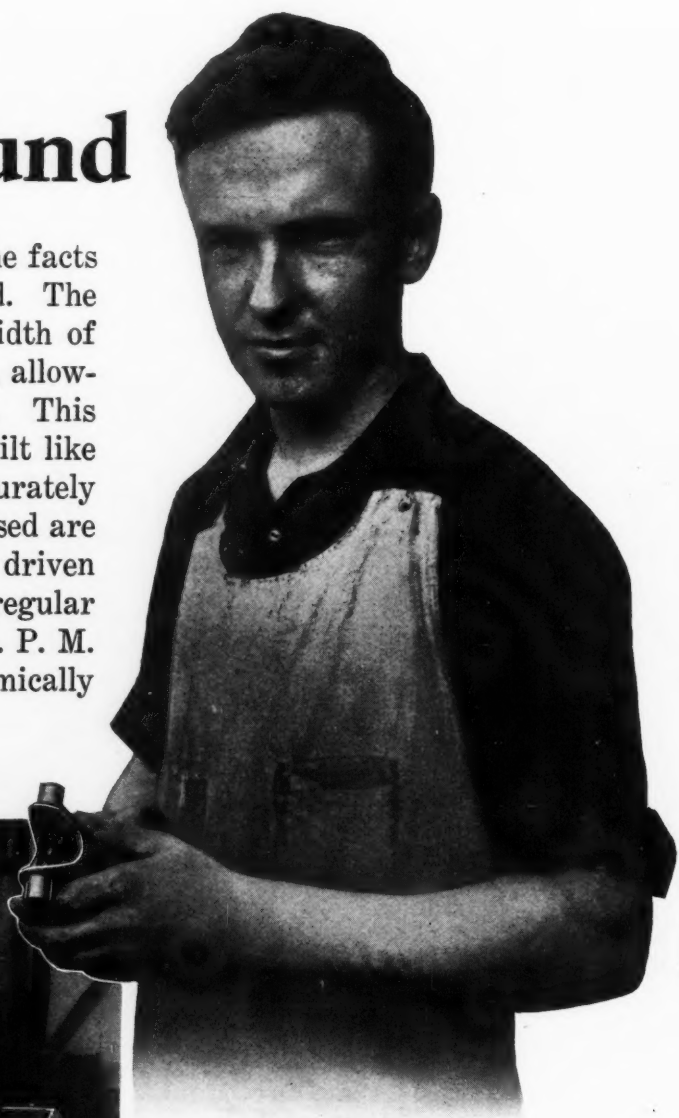
We can solve that grinding problem for **YOU** if you will put it up to us.

**Our Service Department is
waiting for a line from YOU.**

AMERICAN EMERY WHEEL WORKS
PROVIDENCE, R. I.

They're Gardner-ground

Interest in this job centers about the facts of close accuracy and unusual speed. The operator is grinding an over-all width of 3.4375" on universal joint housings, allowable error, plus or minus, 0.0005". This machine is a Gardner Grinder—built like all Gardner machines, to grind accurately under all conditions. The wheels used are Norton 20-K, 16" x 4" x 10", driven smoothly and evenly in the regular Gardner way, at a speed of 1000 R. P. M. Output is 800 accurately and economically ground housings per 10-hour day.



800 Universal Joint Housings in 10 Hours

There is no quicker, surer way of securing a smooth, accurate finish than Gardner grinding—a statement we are ready to prove as soon as you give the word. "Procrastination is the thief of time"—and profits. Write us.

THE GARDNER MACHINE COMPANY

The Largest Manufacturers of
Disc Grinders in the World
BELOIT WISCONSIN

"ABRASIVE" GRINDING WHEELS EXCLUSIVELY

Mr. Storekeeper in one of the steel casting companies has seen a good many grinding wheels come—and go. Then he saw Abrasive Wheels enter the lists, and not only stay, but crowd every other grinding wheel out. It takes "bite," and plenty of it, to handle his company's grinding efficiently and economically. There's "bite" in every abrasive grain. Moreover, Abrasive Wheels are uniform. When a man asks for a duplicate of the wheel he's been using, he gets that particular wheel's "twin."



They've Got the "Bite"

Abrasive Wheels are a sure aid to lower production costs. If your work is material of high tensile strength it calls for "Boro-Carbene" Wheels. For low tensile strength materials we recommend "Electrolon" Wheels. Should you have grinding problems, don't worry about them—send them to us.

New Abrasive Catalog on request.

ABRASIVE COMPANY
BRIDESBURG PHILADELPHIA, U.S.A.

Chicago Branch, 566 W. Washington Blvd.

"ABRASIVE" GRINDING WHEELS

ABRASIVE ORDER No. B 87180

CUSTOMER ORDER No. 13159

SIZE 18x2x2

GRAIN 14 GRADE Q FACE No.

SHAPE SAFETY

TESTED AT 1925

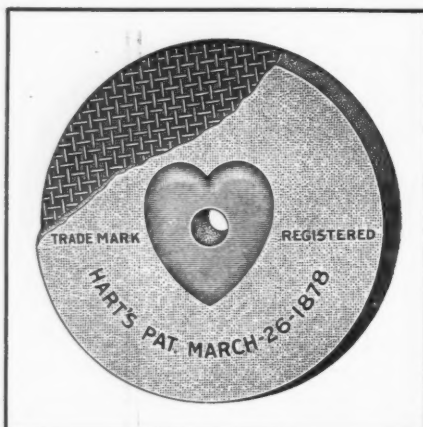
SPEED RECOMMENDED

R. P. M. 1925 to 1275

Speed within above range is dependent on condition of machine, method of grinding and safety appliances used.

Abrasive Material Co.
BRIDESBURG, PHILADELPHIA, U. S. A.
Chicago Branch. 566 W. Randolph St.

Retain tag for duplicate order. (OVER)



Detroit High Grade Grinding Wheels— A Dependable Source of Supply

We furnish reliable wheels for any grinding operation and fill re-orders with *exact duplicates*, at *economical figures*. If you are not grinding with Detroit Wheels just give the line a trial. Catalog.

DETROIT GRINDING WHEEL CO.
DETROIT, MICHIGAN, U. S. A.

The BLOUNT No. 5 Grinder



provides grinding facilities for two men. It's a space and power saver, designed and built to give efficient service. It is rigid, strong and maintains a smooth, even speed. Has self-oiling line reamed bab-bitted bearings, carbon steel spindle ground to size, adjustable wheel guards and can be furnished with surface grinding attachment if desired.

Let us tell you
more about Blount
Grinders

25 Years on the
Market

J. G. BLOUNT COMPANY
EVERETT MASS., U. S. A.

EMERY WHEEL DRESSERS

No. 0 For Small Wheels

No. 2 For Large Wheels



NO. 1 FOR REGULAR SHOP USE

These Dressers in connection with our Cutters make a most powerful and efficient tool, especially our No. 0 for small wheels 6 inches and under, and No. 2 which is made proportionately larger and stronger for large wheels.

CUTTERS

We make the regular "Huntington" (pattern) for No. 0 and "Huntington" (pattern) Paragon Cutter and Roughing Cutter for Dresser No. 1 and the "Huntington" (pattern) and Roughing Cutters for Dresser No. 2. Let us send you descriptive circular and prices.

GEO. H. CALDER, Lancaster, Pa., U. S. A.

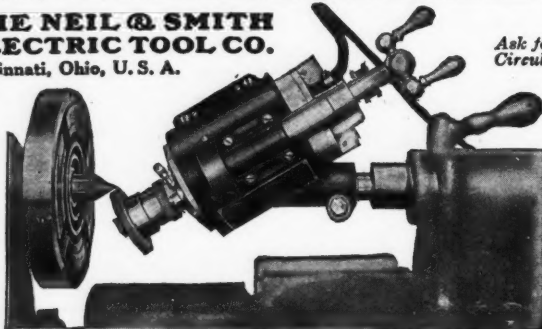
LATHE CENTER GRINDER

Will grind lathe centers mechanically with scientific accuracy in fraction of time required with other methods.

Builders of "Ideal" Patented Portable Electric Tools, Grinders, Drills, Saws, Screw Drivers, Nut, Bolt and Lag Screw Setters.

**THE NEIL & SMITH
ELECTRIC TOOL CO.**
Cincinnati, Ohio, U. S. A.

Ask for
Circular M



The Reason They're Vitrified

Vitrified Grinding Wheels are vitrified to harden the bond, which hardening gives it almost the cutting quality of the abrasive it binds. In addition the evaporation of moisture, due to the intense heat necessary for vitrification, renders the wheels porous, makes them free cutters and eliminates all possibility of glaz-

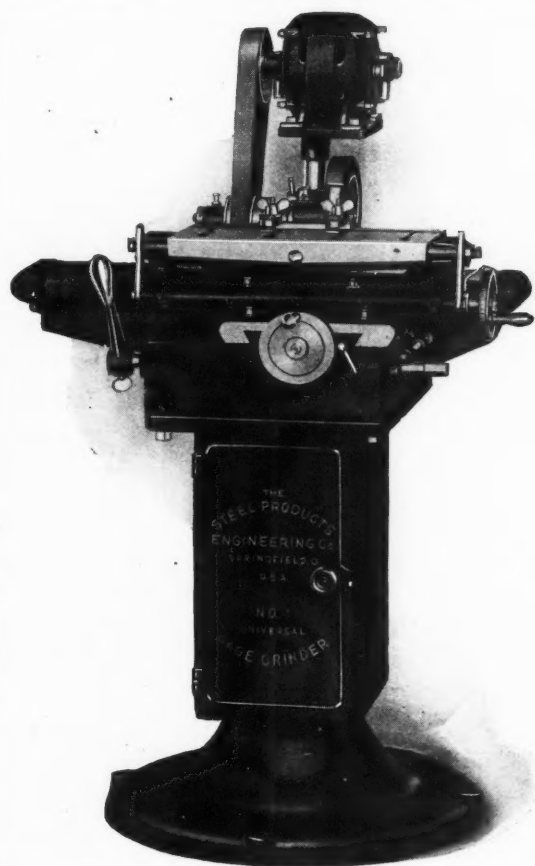


ing or creating sufficient heat to draw temper from the tools.

Vitrified Grinding Wheels are made in all required shapes and sizes. We guarantee satisfaction—replacing any wheel not giving satisfactory service.

Send for Catalog 8

Vitrified Wheel Company
Westfield Mass., U. S. A.



Gauge Grinding

With this machine you get the very highest degree of accuracy with the least possible expense.

Particular attention is called to the flat table and the provisions that have been made for quick, easy adjustments. It is very simple throughout and easy to operate.

Are you familiar with all the details that have helped to make this machine a success?

Let us help you acquire them.

THE STEEL PRODUCTS ENGINEERING CO.

SPRINGFIELD

OHIO

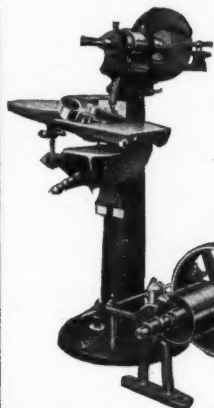
Bryant Chucking Grinder Company

Springfield, Vermont, U. S. A.

Detroit Office: 924 Dime Bank Bldg., Detroit, Mich.

**Builders of One, Two
and Three Spindle
Chucking Grinders.**

\$75.00 No Better Grinder for the Money

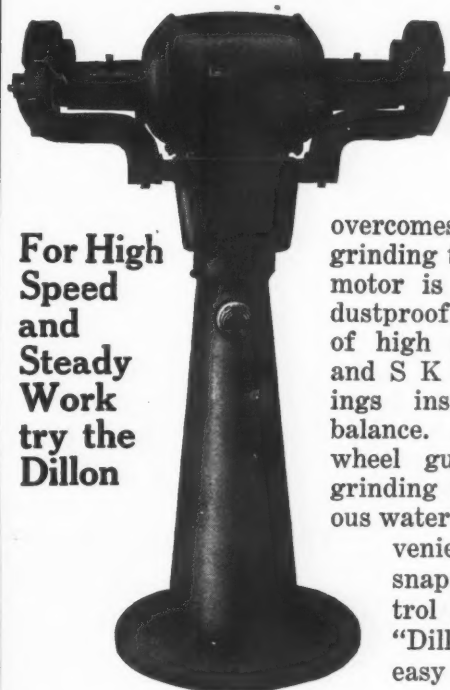


AT this price the "Waterbury" Toolroom Die and Surface Grinder is surely a paying investment. It is adapted for a wide variety of work, is fast and accurate, fitted with up-to-date conveniences and means for compensating wear, strong and rigid throughout, lasting in service. Better values for the money would indeed be hard to find.

Detailed description on request

The Blake & Johnson Co.
WATERBURY, CONN.

Solid Comfort in Grinding



The
**DILLON
Electric
Grinder**

**For High
Speed
and
Steady
Work
try the
Dillon**

overcomes the usual grinding troubles. The motor is rugged and dustproof. Large shaft of high carbon steel and S K F ball bearings insure perfect balance. Extra heavy wheel guards, broad grinding rests, generous water cup and conveniently placed snap switch control make the "Dillon" safe and easy to operate.

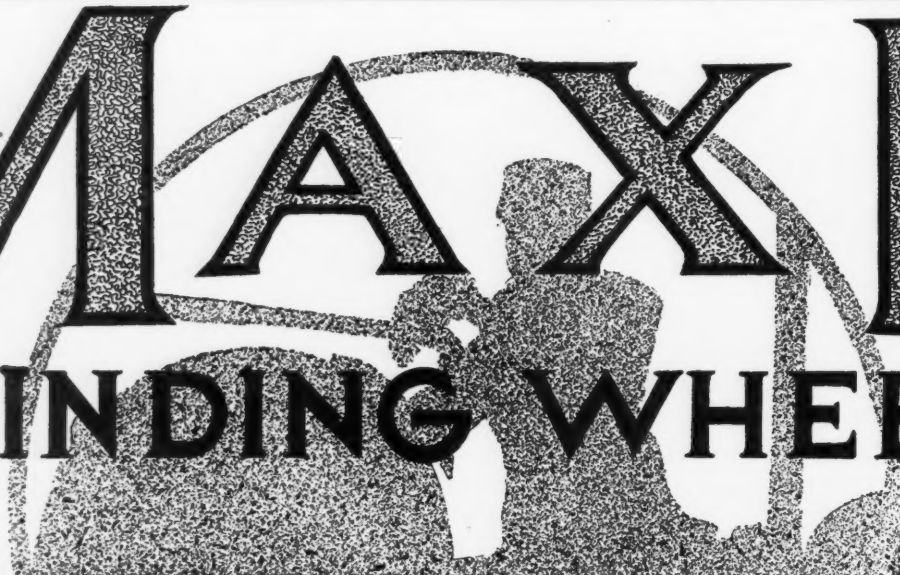
THE DILLON ELECTRIC COMPANY
CANTON OHIO, U. S. A.

MAXF

GRINDING WHEELS

MAXF=
MAXIMUM
EFFICIENCY

WHEELS
TO GRIND
ANYTHING



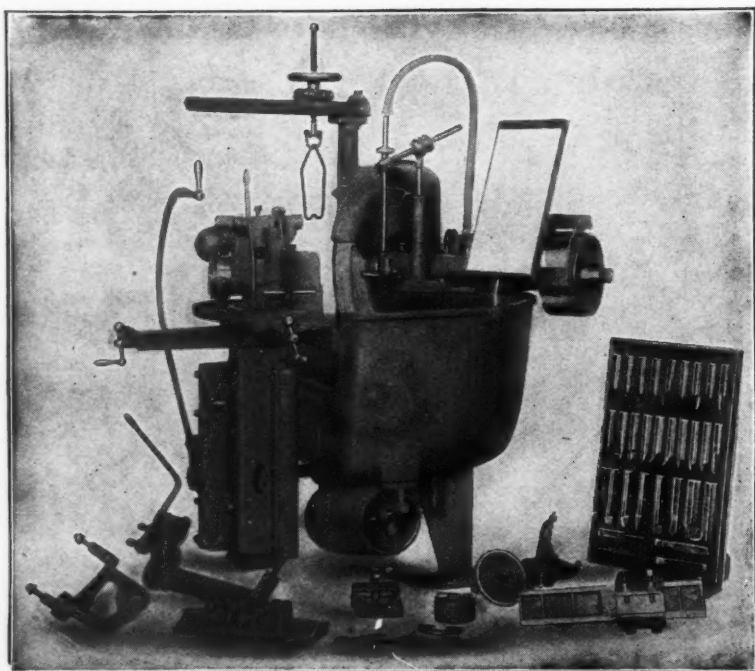
Are You Grinding Down Your Efficiency ?

ONE weak tool lowers the efficiency of the whole shop. If grinding is your weak spot write us about it. MAXF Grinding Service not only supplies wheels for every grinding need, but puts the knowledge and experience of its engineers at your disposal to advise you in your selection. This makes us responsible for the result and guarantees your grinding service.

SPRINGFIELD GRINDING CO., Factory and Sales Dept. **Chester, Mass.**

William Sellers & Co. Incorp.

PHILADELPHIA, PA.



Labor Saving Machine Tools

Three of the reasons why machine shops find **THE SELLERS TOOL GRINDER** so profitable that it is regarded as indispensable, are

Large Output
Accurate Work
Low Cost of Maintenance

For quickly, correctly and economically forming and grinding cutting tools for Lathes, Planers, Slotters, etc., it is without an equal. It produces and duplicates any desired shapes and angles. Tools treated by it do much more work before regrinding than when sharpened in any other way.

Does not require a mechanic for operator.
Saves grinding time. Saves money.

Shafting - Drill Grinders



FRANKFORT

INDUSTRIAL

FURNACES

for oil, natural gas or manufactured gas

Standard Types for Every Need—

THE average furnace order is a rush order—that is, there is urgent need for the furnace well in advance of its installation. In such cases standard furnaces—requiring no special patterns, special machine work or special castings—are the buyer's salvation.

The 75 standard furnaces of the Frankfort family give the buyer the opportunity to buy exactly what he needs and buy it **practically from stock**. Delivery becomes merely a matter of assembling.

CATALOG—?

Catalog 8-M (1917 Edition) shows the latest improvements in heat-treating equipment. Do you want a copy?

*For Fast Delivery Consult
Our Furnace Department.*

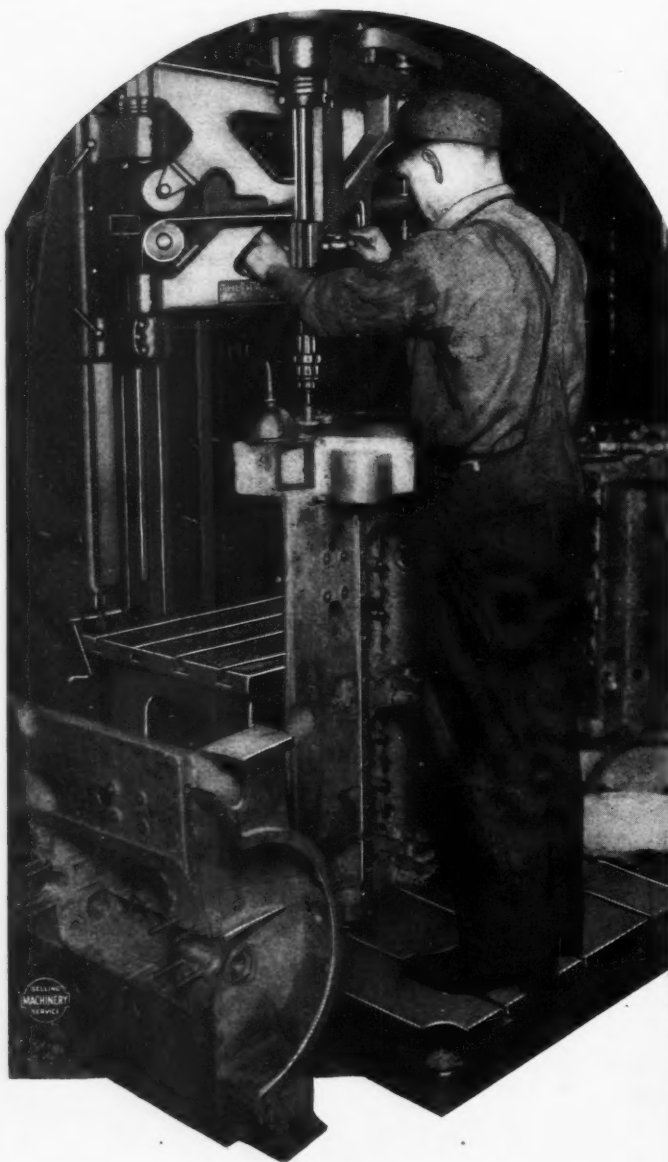
The Strong, Carlisle & Hammond Co.
Frankfort Avenue Cleveland, Ohio

BRANCHES:

Boston
New York

Chicago
Philadelphia

Detroit
Pittsburgh



THE HAMMOND RADIAL As a Manufacturing Machine

The shop in which this photograph was secured is known as the "little shop with the big production," and the "Hammond" plays no small part in enabling it to merit the distinction. For example, on this crankcase job, eight 5/16" holes are drilled, and eight 3/8"-16 P holes tapped at one setting, operation necessitating bolting flywheel to the case and taking down again when finished. Regardless of this detail, 120 cases—1920 holes—are completed every 9½ hours. "Hammond" service pays here—will pay in your shop, too. Try it.

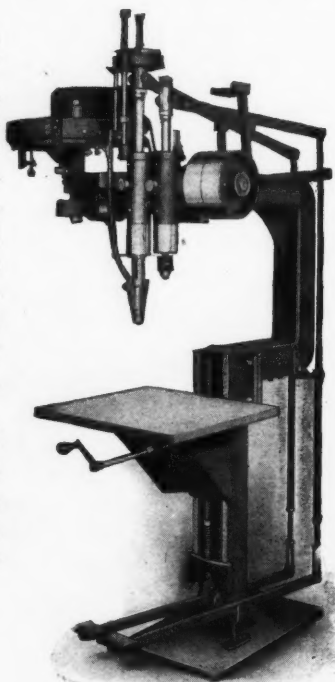
THE HAMMOND MFG. CO.
CLEVELAND, OHIO

Save Time and Avoid Inaccuracy

Many an able man can't set a screw straight by hand, but any intelligent boy can operate the Reynolds Automatic Screw Driving Machine and average two to five times greater output than by hand methods. Every screw sets true.

Adapted for wood or metal. Screws may be driven flush or to any desired depth by automatic adjustment.

*Catalogue Gives
Details—write
for Yours Today*



Our Record is 18,000 Screws set in 10 hours

REYNOLDS PATTERN & MACHINE CO.
MASSILLON, OHIO



Your Choice of Three ROCKFORD DRILLS

SINGLE PULLEY, DOUBLE PULLEY or DIRECT DRIVE with variable speed motor—whichever meets your special drilling requirements.

All three have the same rigid frame; the same rapid operation and easy control, four instantaneous feed changes and a trip lock for throwing out feed automatically at point set. All of them will drive high-speed drills up to 2½ inches diameter.

There's work for at least one of these modern, heavy duty drills in your shop.

*Write
for
Booklet*

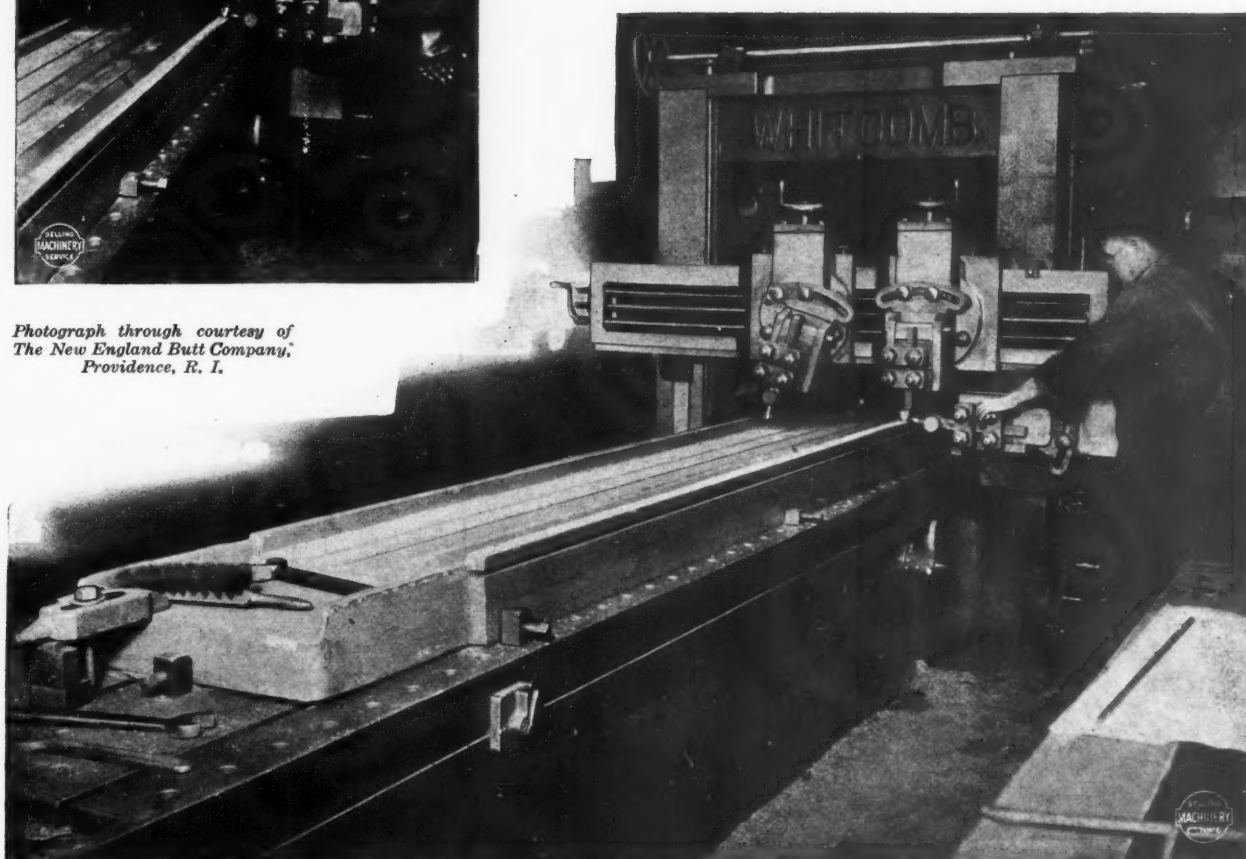
Rockford Drilling Machine Company
ROCKFORD ILLINOIS

A Whitcomb-Blaisdell Planer



*Photograph through courtesy of
The New England Butt Company,
Providence, R. I.*

Which is Described by
Its Operator as "One of
the Finest Machines in
the City of Providence"



There are other planers in this plant but the Whitcomb-Blaisdell 36" x 42" x 14' Planer, with its three heads, individual motor drive, hand-operated dogs, trouble-proof head-raising mechanism and second-belt features is the leader of them all—and we have the company's own word for it.

On work such as illustrated, planing large grinder bases, the roughing cuts are as heavy as one-half inch, through sand, scale and tough iron; but it is impossible to stall the planer. And it takes the finishing cuts to just as close limits as are needed.

When you buy a Whitcomb-Blaisdell Planer you get the
maximum in planer service. Let us send the catalogue.

WHITCOMB-BLAISDELL MACHINE TOOL CO.
WORCESTER, MASS., U. S. A.



Dreadnought HIGH SPEED STEEL

Makes Durable Inserted Tooth Cutters

Dreadnought tools stand up in a noteworthy way under hard usage. For example, here's a tool 14" diameter with 17 inserts of $\frac{5}{8}$ " square Dreadnought High Speed Steel, that works like a charm in sandy iron castings. The work is part of a clothes pressing machine, is 13" wide at widest part, and 39" in length. Notwithstanding the edge-dulling nature of the work, this Dreadnought Cutter cleans up a round 200 castings before the inserts have to be re-ground. Dreadnought is the prince of steels for hard service cutters, lathe and planer tools, etc. Economical production depends to a great degree on the wearing and working qualities of your tools.

Unless you know your present tool equipment is the most profitable for your work, give Dreadnought Steel a trial.

HALCOMB STEEL COMPANY
SYRACUSE **NEW YORK**

Branches: Chicago, Cleveland, Philadelphia, Boston, New York

Remarkable Ductility of "NATIONAL" Pipe

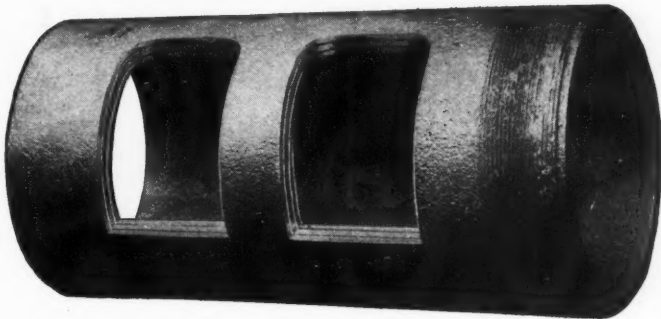


170 quarts of nitroglycerine failed to crack this piece of "NATIONAL" Casing. The terrific force of the explosion reduced the length from about 18 feet to less than 6; although crushed, twisted and distorted there was no fracture.

"NATIONAL" Pipe for Mechanical Purposes



This piece of 10-inch "NATIONAL" Casing dropped 236 feet through a 12½-inch hole without fracturing the material. Although the end is distorted, as the thread protector was driven up over the threads by the force of the impact, THE MATERIAL SHOWS NO SIGN OF FRACTURE.



1440 feet of 8¼-inch "NATIONAL" Casing dropped 200 feet in a well, and as a result of the impact on solid stone three sections of the casing were telescoped with NO SIGN OF FRACTURE.

These three illustrations should be convincing proof of the extraordinary ductility of "NATIONAL" Pipe. No mill test ever devised could equal the terrific strains effected by the unusual accidents which produced the results shown.

¶ It is therefore a reasonable deduction that as "NATIONAL" Pipe has withstood such enormous forces without a fracture in the material, it is essentially qualified to withstand the strains incident to the mechanical uses for which it is recommended.

¶ As a matter of fact "NATIONAL" Pipe is used for thousands of parts of different machines which are used for thousands of different purposes.

¶ The inherent ductility of "NATIONAL" Pipe lends itself most satisfactorily to mechanical manipulations, and in service withstands without failure the jars and shocks to which the incessant vibrations of machinery are inevitably subjected.

¶ To readily identify "NATIONAL" material and as protection to manufacturer and consumer alike, the practice of National Tube Company is to roll in raised letters of good size on each few feet of every length of welded pipe the name "NATIONAL" (except on the smaller butt-weld sizes, on which this is not mechanically feasible; on these smaller butt-weld sizes the name "NATIONAL" appears on the metal tag attached to each bundle of pipe).

¶ When writing specifications or ordering tubular goods, always specify "NATIONAL" pipe, and identify as indicated.

LOOK FOR THE MARK

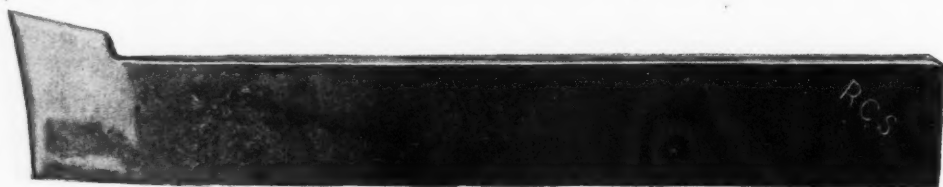
Name Rolled in Raised Letters on National Tube Company Pipe

¶ In addition, all sizes of "NATIONAL" welded pipe four in. and under are subjected to a roll-knobbling process known as Spellerizing to lessen the tendency to corrosion, especially in the form of pitting. This Spellerizing process is peculiar to "NATIONAL" pipe, to which process National Tube Company has exclusive rights.

¶ "NATIONAL" pipe was awarded the GRAND PRIZE (highest possible award) at Panama Pacific International Exposition, 1915.

NATIONAL TUBE COMPANY, General Sales Offices Frick Building PITTSBURGH, PA.

DISTRICT SALES OFFICES: Atlanta Boston Chicago Denver Kansas City New Orleans
 New York Omaha Philadelphia Pittsburgh St. Louis St. Paul Salt Lake City
 PACIFIC COAST REPRESENTATIVES: U. S. Steel Products Co., San Francisco Los Angeles Portland Seattle
 EXPORT REPRESENTATIVES: U. S. Steel Products Co., New York City.



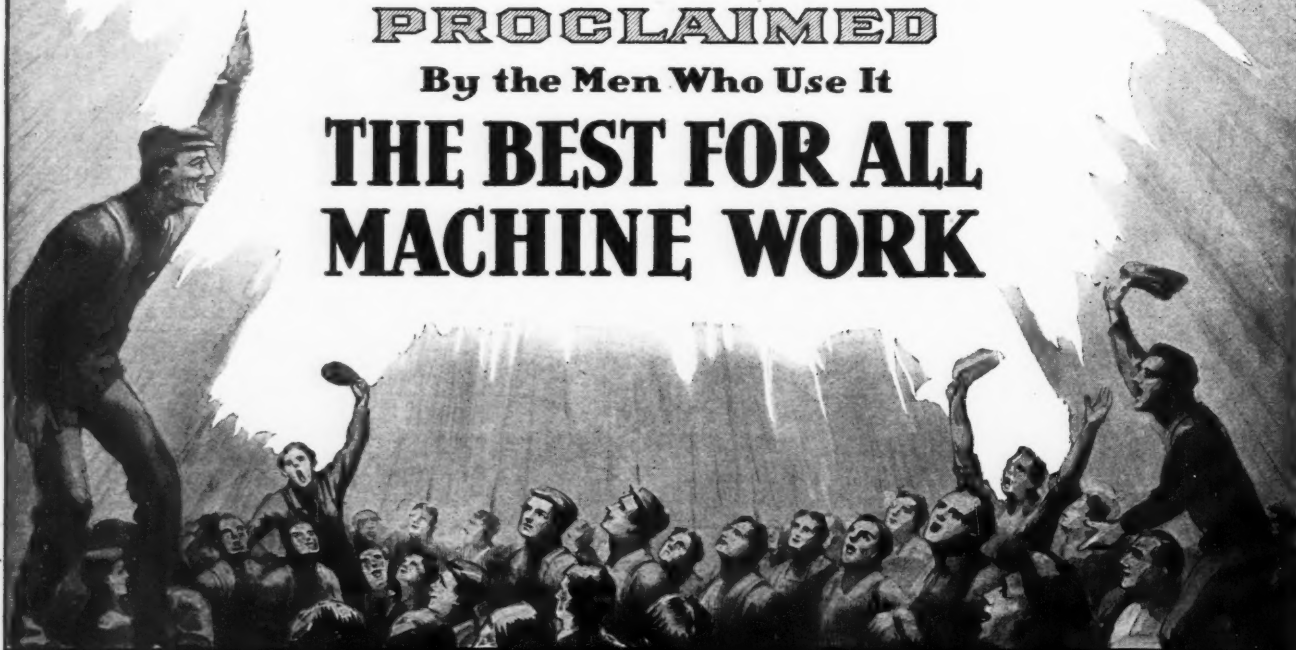
Red Cut Superior

The Nationally Known First Quality
HIGH SPEED STEEL

PROCLAIMED

By the Men Who Use It

**THE BEST FOR ALL
MACHINE WORK**



VANADIUM-ALLOYS STEEL CO.
PITTSBURGH, PA. WORKS AT LATROBE, PA.

E. T. WARD'S SONS
44 Farnsworth St. BOSTON, Mass.

GEO. NASH CO.
304 Hudson St. NEW YORK N.Y.

Carried in Stock in These Warehouses:
FIELD & CO. Inc.
721 Arch St. PHILADELPHIA, Pa.

VANADIUM-ALLOYS STEEL CO.
PITTSBURGH, Pa. & LATROBE, Pa.

GEO. NASH CO.
64 G Washington Blvd CHICAGO, Ill.

A New Chain-Pipe Wrench

by the

Billings & Spencer Company



The above cut shows the wrench in its two positions

which, for the first time in the construction of this type of wrench, accomplishes reversibility of action—works either way without disengaging and turning.

The Billings Chain-Pipe Wrench, because of its new and exclusive feature, saves many an hour and solves many an awkward situation. Read the facts:

The important and exclusive feature of this wrench is its double-action or reversibility. Pipe can be turned in either direction without the process of removing and turning over the wrench. This is due to the angular position of the elliptical jaws, which allows the engagement of either the outer or inner teeth.

The combination feature of this wrench consists of its adaptability to pipe fittings and short connections, as well as ordinary pipe. By removing the outside elliptical jaws, thereby bringing into play the narrow jaw attached to the under part of the handle, the wrench is immediately converted into an efficient tool for narrow or irregular work where a broader wrench would be ineffectual.

The elliptical jaws are serrated on all sides and may be easily changed end for end, thus giving double life to the wrench.

With the outer jaws removed, the wrench is available for nut and bolt heads, as well as pipe fittings.

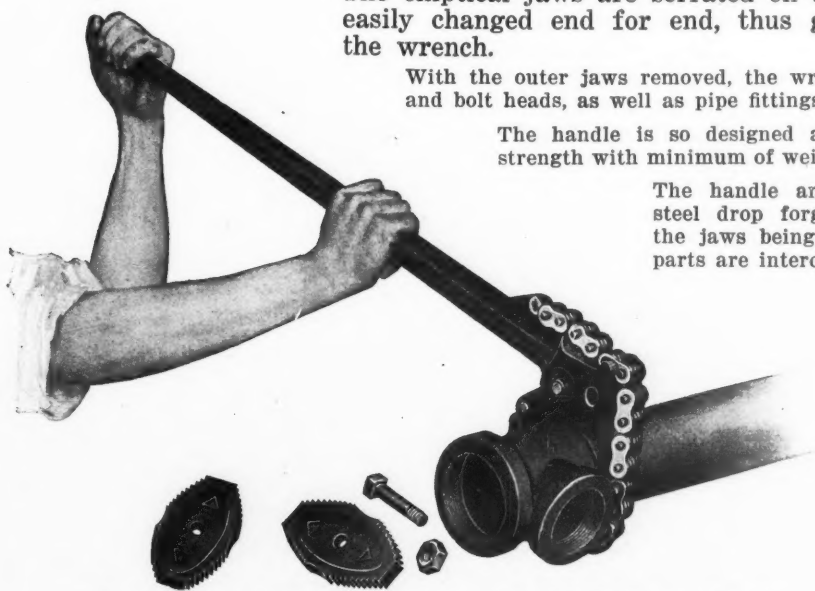
The handle is so designed as to give the necessary strength with minimum of weight.

The handle and jaws are made from steel drop forging of superior quality, the jaws being carefully hardened. All parts are interchangeable.

The tool is made with either a flat link or cable chain. The chains are made in our own factory, and are of sufficient safety-test to insure an absolutely reliable tool.

Prompt Deliveries

Descriptive literature and price lists upon request.



The above cut shows the wrench as adapted to fitting nipples, etc.

**THE BILLINGS
& SPENCER CO. 
HARTFORD, CONN. U. S. A.**

JESSOP'S "ARK"

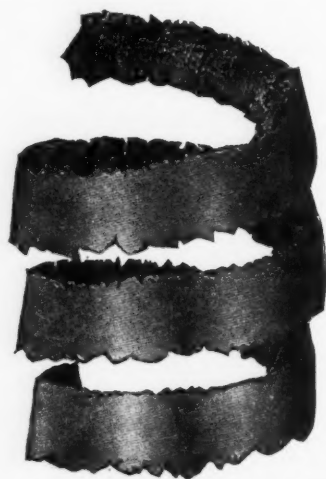
Has an Unexcelled Record.



HIGH SPEED STEEL

Note the Following Facts.

In turning 100 railway car wheel tires, Jessop's "Ark" High Speed Steel has the record of losing less steel, due to grinding, than any other make.



The actual amount of steel ground off the tool in turning 100 wheels was 3 ounces. This is an unrivalled performance in steel economy.

We have a large stock of Carbon Tool Steel and High Speed Steel. Write for Catalogue.

WM. JESSOP & SONS, Incorporated
91 JOHN STREET, NEW YORK, N. Y.

Boston Warehouse: 163 High Street

Branch Warehouses throughout the United States

DRILL VISE

MOV. PLATE FOR SINGLE BUSHING
MAKE PLATE FOR SEVERAL BUSHINGS
AND TO SUIT THE WORK

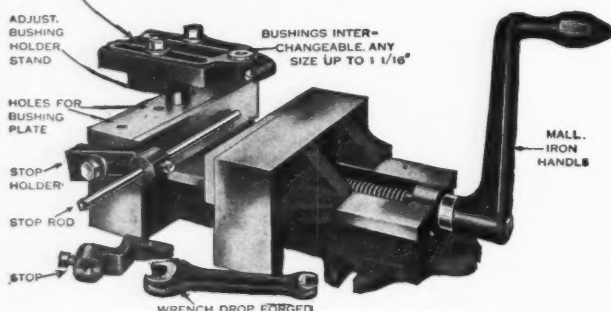


Fig. 1. With Jig Attachments

Always a good vise for general shop use on drill, miller, shaper or planer, and at the same time holds work for duplicate drilling without the cost of a jig.

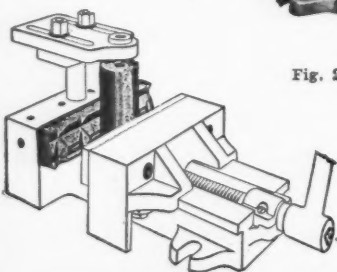


Fig. 3. V-Jaw for Round Work

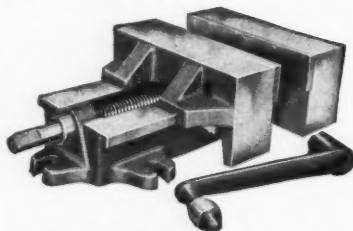


Fig. 2. Without Jig Attachments

All Patented. Send for Circular.

The Graham Mfg. Co.
Providence, Rhode Island

Great Britain: C. W. Burton, Griffiths & Co. Germany, Austria-Hungary, Scandinavia: A. Kayser, Berlin. S. W. 68. France, Italy, Switzerland, Spain and Holland: Fenwick Freres & Co.

DRILL SPEEDER

For use in Drillers from 20-inch to Largest Radial
For Twist Drills 0" to 3/4" requiring speeds up to 3000 R. P. M.

WISE

No. 3, jaws 6", opens 4 1/2", with attachments, \$22.00; without, \$20.00. List.

No. 4, jaws 9", opens 7", with attachments, \$27.50; without, \$25.00. List.

No. 5, jaws 12", opens 9 1/2", with attachments, \$40.00; without, \$36.00. List.

**INCREASES
THE SPEED
3
TIMES**

DRILL SPEEDER

No. 2, with chuck, drills 0" to 5/16". List, \$25.00.

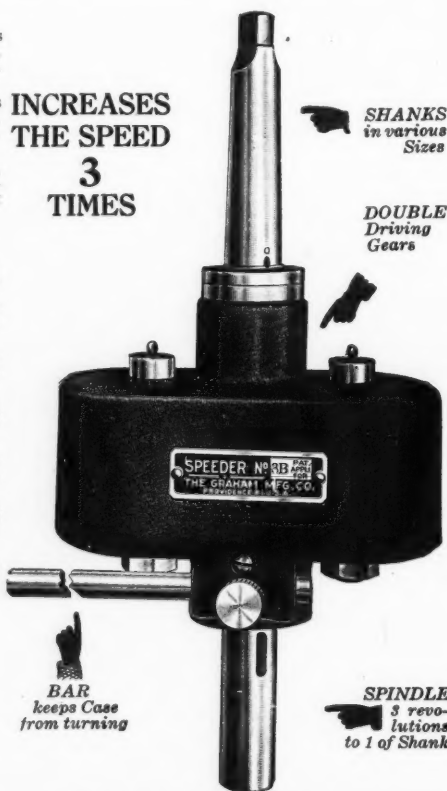
No. 3, with chuck, drills 0" to 1/2". List, \$27.50.

No. 3B, with No. 1 Morse hole instead of chuck, \$27.50.

No. 4, with chuck, drills 0" to 3/4". List, \$40.00.

No. 4B, with No. 2 Morse hole instead of chuck, \$33.00.

No. 2L, with chuck, drills 0" to 3/4". Has feed lever mechanism. List, \$33.00.



BAR
keeps Case
from turning

SPINDLE
3 revolutions
to 1 of Shank

This cut shows Nos. 3B and 4B only. There are two other styles and sizes.



TRADE MARK
Starrett Tools
 REG. U.S. PAT. OFF.
Tell the Truth

After all, the principle of micrometers and other fine measuring tools is quite simple. The only requirement is that they tell the truth.

This test indicator, for example, has done its full duty when it has registered its story in thousandths.

Starrett Tools have a reputation for truth telling. Their character is well established. That's why it pays to use the line of 2100 styles and sizes of micrometers, calipers, gages, squares, height and depth gages, and other precision tools described in our Catalog No. 21 D.

The L. S. Starrett Co., Athol, Mass.
The World's Greatest Toolmakers





Properly Treated Alloys and Metals That
Answer Any Condition or Requirement

PRECISION DIE CASTINGS

protect you against the burden of in-
creased cost of materials.

The Precision Organization is *precise*
in die making—in alloying metals—
in castings and in deliveries.

Our representative will gladly call and
show you samples.

PRECISION DIE CASTING CO.
INCORPORATED
SYRACUSE, N. Y.

Castings in aluminum alloys, all bearing
metals, spelter and lead.

*Special requirements given prompt atten-
tion. Representatives in New York, Cleve-
land and Detroit.*

ELECTRITE URANIUM STEEL

This planer hand is happy—and with good reason. He has a lot of stock to remove from the plate he is finishing and he has a tool that will carry a good cut—an Electrite Uranium High Speed Steel Tool. He is planing 40—50 point carbon steel with a 1/16 inch speed and a 1/2 inch deep chip. The reason for the staying quality in Electrite Uranium High Speed Steel is due largely to the element Uranium that is introduced by the most modern steel working practice. Uranium gives this steel a toughness that is unattainable in other ways.

Besides Electrite Uranium we make "Mangano" oil hardening non-shrinkable die steel; "Select" die steel for hot work and hot trimming dies; "Renown" die steel, which is a special vanadium steel; also chrome and tungsten magnet steels.

Try us on your next steel order.

**"The Smile
that Won't
Come Off"**

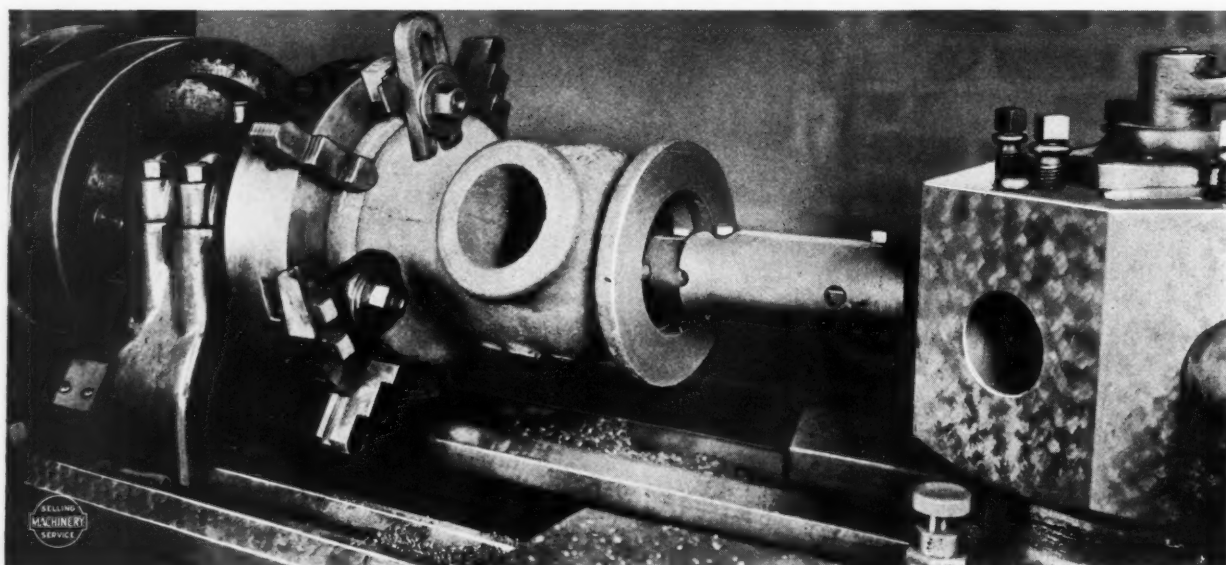
Photograph and data
through courtesy of
Mackintosh, Hemphill &
Company, Pittsburgh.



LATROBE ELECTRIC STEEL CO., LATROBE, PA.

LATROBE ELECTRIC STEEL CO.,
165 Broadway, New York City, N. Y.
LATROBE ELECTRIC STEEL CO.,
1001 Ford Bldg., Detroit, Mich.
LATROBE ELECTRIC STEEL CO.,
2802 Union Central Bldg., Cincinnati, O.
LATROBE ELECTRIC STEEL CO.,
Commercial Trust Bldg., Philadelphia, Pa.
MR. GEORGE F. HARTMAN,
664-66 Spitzer Bldg., Toledo, O.
BETZ-PIERCE COMPANY.....Cleveland, O.

McMINN & QUIGLEY STEEL CO.,
40 Central St., Boston, Mass.
ELECTRIC METALS COMPANY,
First National Bank Bldg., Pittsburgh, Pa.
HOYT-NOE STEEL COMPANY,
Monroe and Jefferson Sts., Chicago, Ill.
THE DICKERSON COMPANY.....Dayton, O.
C. W. BALDY.....198 Cleveland Ave., Buffalo, N. Y.
JNO. H. HEIMBUECHER METALS CO.,
514 North Third St., St. Louis, Mo.
C. W. RICKARD.....Seattle, Wash.



BLUE CHIP HIGH SPEED STEEL

Boosts Boring and Turning Output

The work is cast iron valve bodies which are made in large quantities by a New England manufacturer. When higher production was required heavier turning lathes were installed, but no change was made in the tools. It was a *Blue Chip High Speed Steel* job on the old machines; the same tools are handling it now under a drive that means *100% increase in output*.

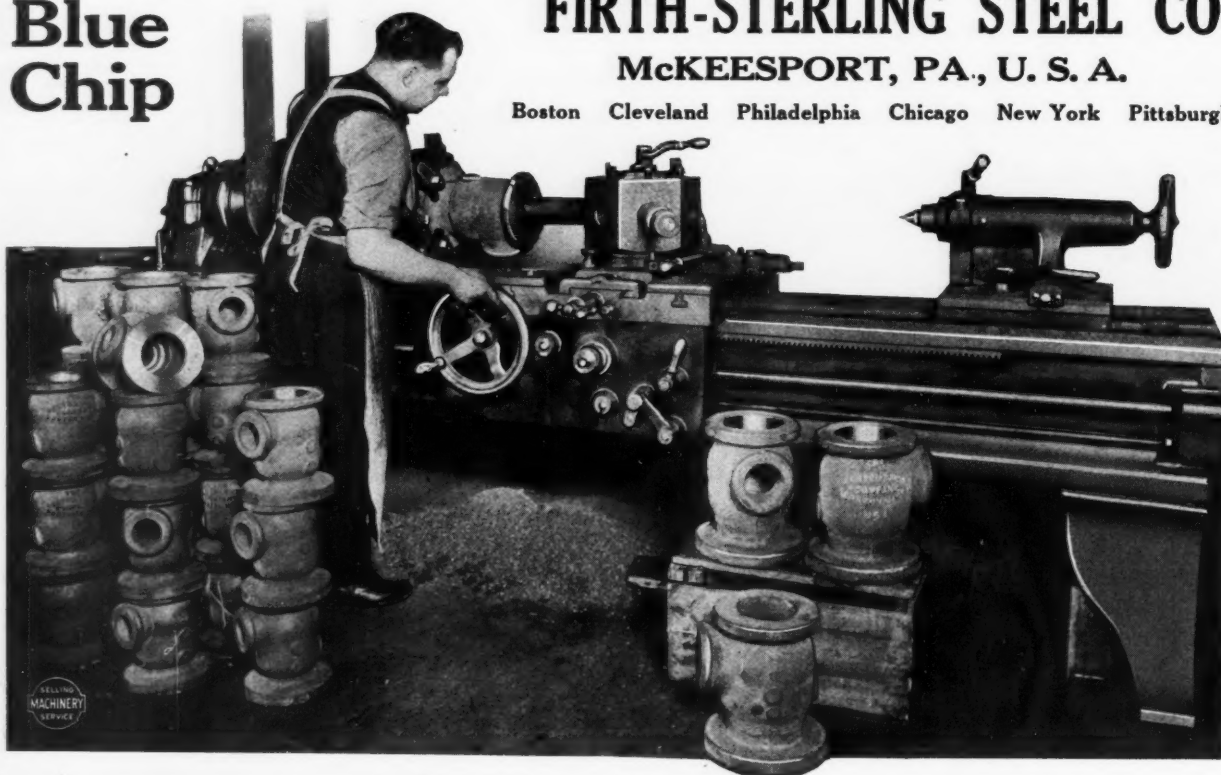
The work is particularly hard on tools; material is hard and scaly; for boring and facing the tool must work from the end of a 12" bar, on a casting that overhangs 12" from the faceplate; cut varies from 1/8" to 3/16" deep and not a chatter mark is to be seen. Tools made from *Blue Chip High Speed Steel* stand all the power the heaviest machines are capable of pulling. For turning and boring tools, taps, dies, reamers, etc. Write us.

**Blue
Chip**

FIRTH-STERLING STEEL CO.

McKEESPORT, PA., U. S. A.

Boston Cleveland Philadelphia Chicago New York Pittsburgh

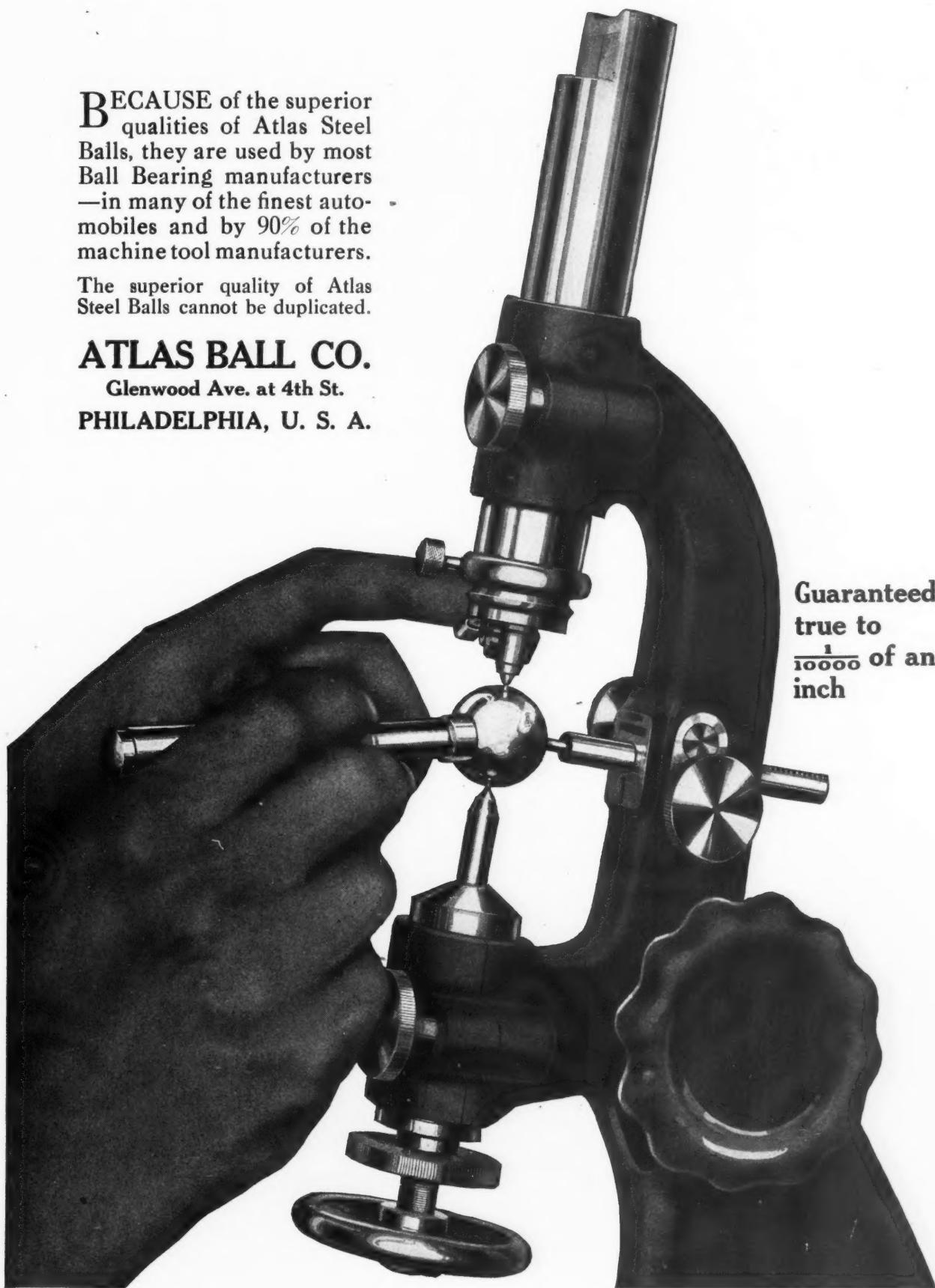


BECAUSE of the superior qualities of Atlas Steel Balls, they are used by most Ball Bearing manufacturers—in many of the finest automobiles and by 90% of the machine tool manufacturers.

The superior quality of Atlas Steel Balls cannot be duplicated.

ATLAS BALL CO.

Glenwood Ave. at 4th St.
PHILADELPHIA, U. S. A.



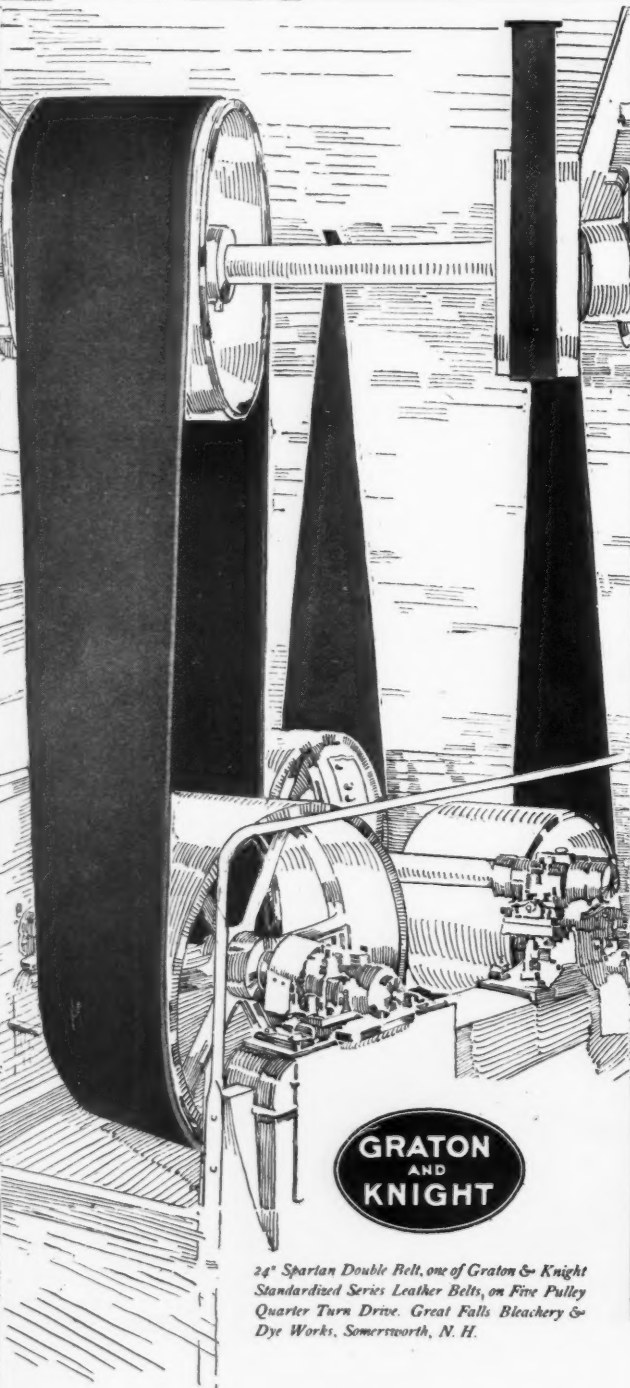
Guaranteed
true to
 $\frac{1}{10000}$ of an
inch

GRATON & KNIGHT

Standardized Series

LEATHER BELTING

Tanned by us for belting use



24" Spartan Double Belt, one of Graton & Knight Standardized Series Leather Belts, on Five Pulley Quarter Turn Drive. Great Falls Bleachery & Dye Works, Somersworth, N. H.

It Begins in the Tannery

Leather is the standard belting material

To us, the largest belting makers in the world, every possible belting material lies open for selection and use. But the belting experience of generations points to the unescapable fact that leather has the properties necessary to make good belting.

Leather that is properly tanned for belting is tough, flexible, durable and prehensile. It preserves the natural softness and mobility of the skin, ensuring an effective grip on the pulley surface.

We have standardized these requirements of perfectly tanned belt leather. The standard in each case is the highest *working* efficiency in the finished belt.

Since the market cannot supply tanned belt leather that continuously measures up to Graton & Knight Standards, we tan our own hides. Last year we tanned 285,000 of them, in our own tannery. We tanned them for *belts*. We tanned them to definite and uniform standards of belting requirements.

This standardization of material is the foundation of Graton & Knight quality.

It makes the Standardization of Graton & Knight Belts an actual, practical thing.

Think what other standardized products have done for you—and consider the standardization of belting on that basis. Let us send you complete information on the subject.

The Graton & Knight Mfg. Company

Oak Leather Tanners and Makers of Leather Belting
Worcester, Massachusetts, U. S. A.

BRANCHES

Atlanta, Boston, Chicago, Cleveland, Detroit, Fall River, Kansas City, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Seattle, St. Louis, Leicester, England.

SELLING AGENTS

Graton & Knight Mfg. Co. of Texas, Dallas, Texas. Graton & Knight Mfg. Co. of Wisconsin, Milwaukee, Wis. Graton & Knight Mfg. Co. of California, San Francisco, Cal.

One Concern Buys 200 to 300 Every Month

When the photographer snapped this 300-lot of "Pioneer" Pressed Steel Hangers consigned to the Jones & Lamson Machine Company, he learned something of the J. & L. hanger supply. For example, buyers of Jones & Lamson machines have their choice of hanger equipment; if they simply specify "best equipment," they are furnished "Pioneer" Hangers—and from 200 to 300 "Pioneer" Hangers per month is the regular Jones & Lamson order.

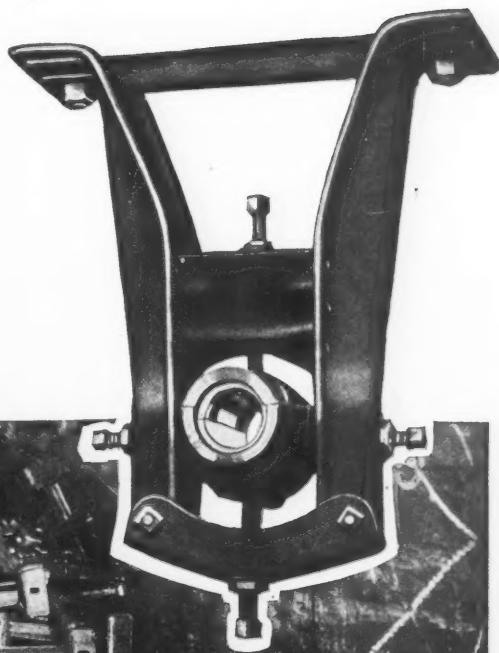
"Pioneer" Hangers are designed to carry the tremendous weight of shafting, couplings, pulleys, etc., and stand the tug of belts with absolute safety. They are made from open-hearth steel, weigh only one-third as much as cast-iron hangers, cost less to haul and erect, are guaranteed unbreakable, and are actually the cheapest hangers you can install.

Machine tool builders give "Pioneer" hangers the preference for "safety-first" reasons and for quality. Write for booklet, "Transmission Data."

Standard Pressed Steel Co.
PHILADELPHIA, U. S. A.

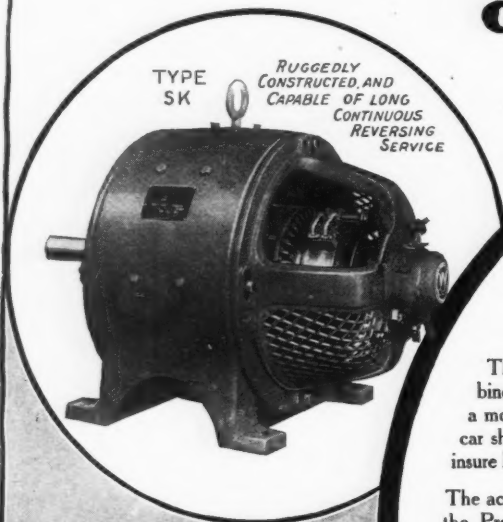


"Pioneer"
STEEL
HANGERS



Westinghouse

Reversing Planer Motors and Control



The Right Motor At The Right Time

The right motor is that one which will give you the most intense production, combined with high efficiency and utmost reliability. And NOW is the right time for such a motor. Our government must depend primarily for means of transportation upon the car shops, and it naturally follows that the car shops should employ those methods which insure MAXIMUM OUTPUT in MINIMUM TIME with HIGHEST EFFICIENCY.

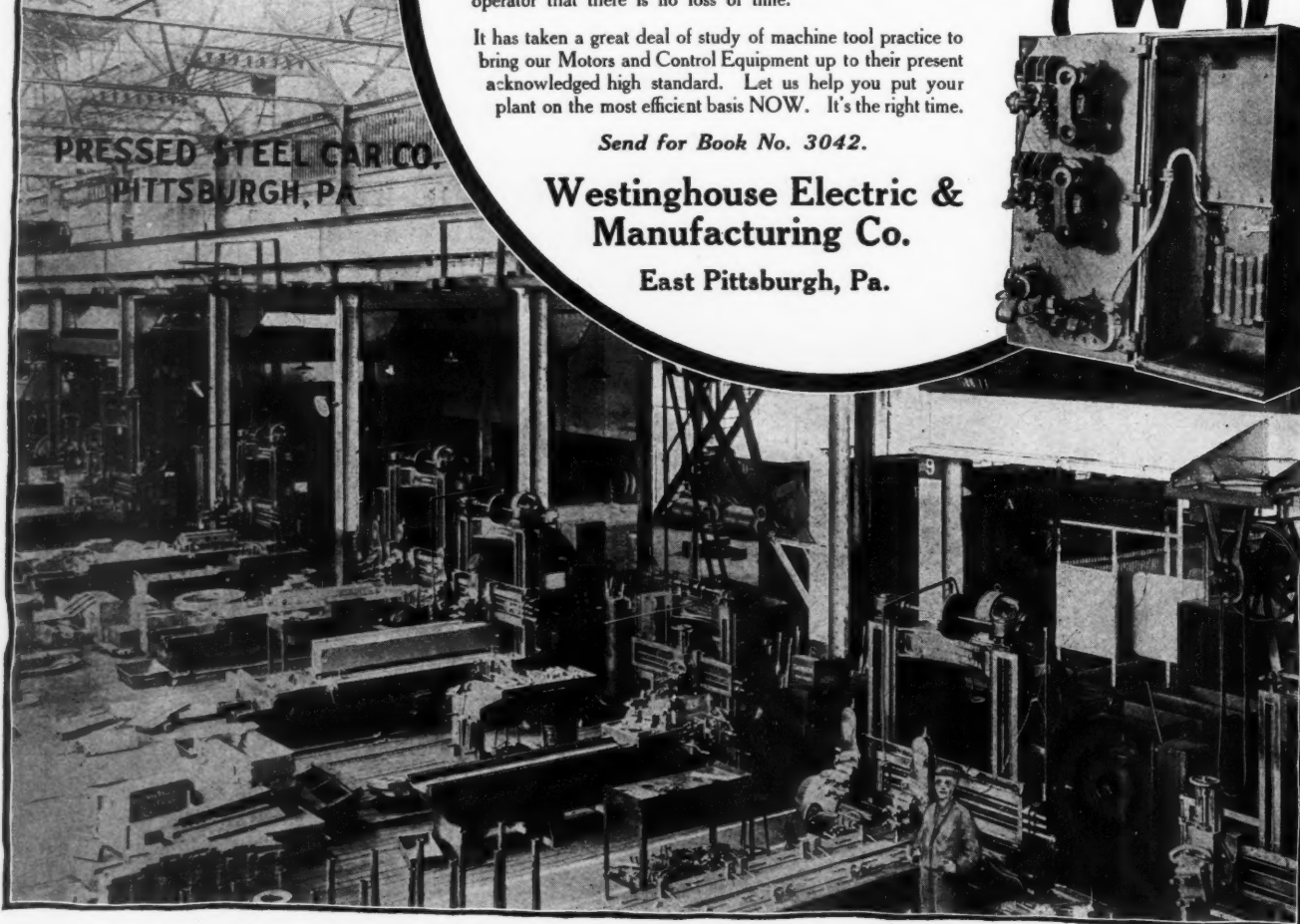
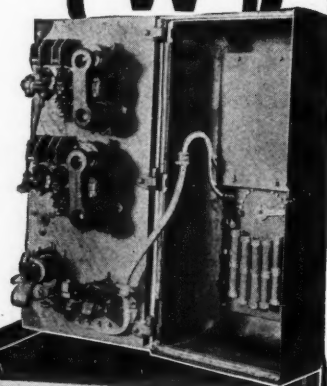
The accompanying views show a portion of the machine shops of the Pressed Steel Car Co. of Pittsburgh and the Westinghouse Reversing Planer Motors employed on these planers. Westinghouse Automatic Control, also installed, so simplifies the work of the operator that there is no loss of time.

It has taken a great deal of study of machine tool practice to bring our Motors and Control Equipment up to their present acknowledged high standard. Let us help you put your plant on the most efficient basis NOW. It's the right time.

Send for Book No. 3042.

**Westinghouse Electric &
Manufacturing Co.**

East Pittsburgh, Pa.



Grinding Bushings On Drilling Jigs

This is one of the many jobs where the DUMORE comes in handy in a tool room. The hardened steel bushings in this Drilling Jig must be finished accurately and both bushings must be ground at the same operation in order to insure perfect alignment. The

DUMORE PORTABLE ELECTRIC GRINDER

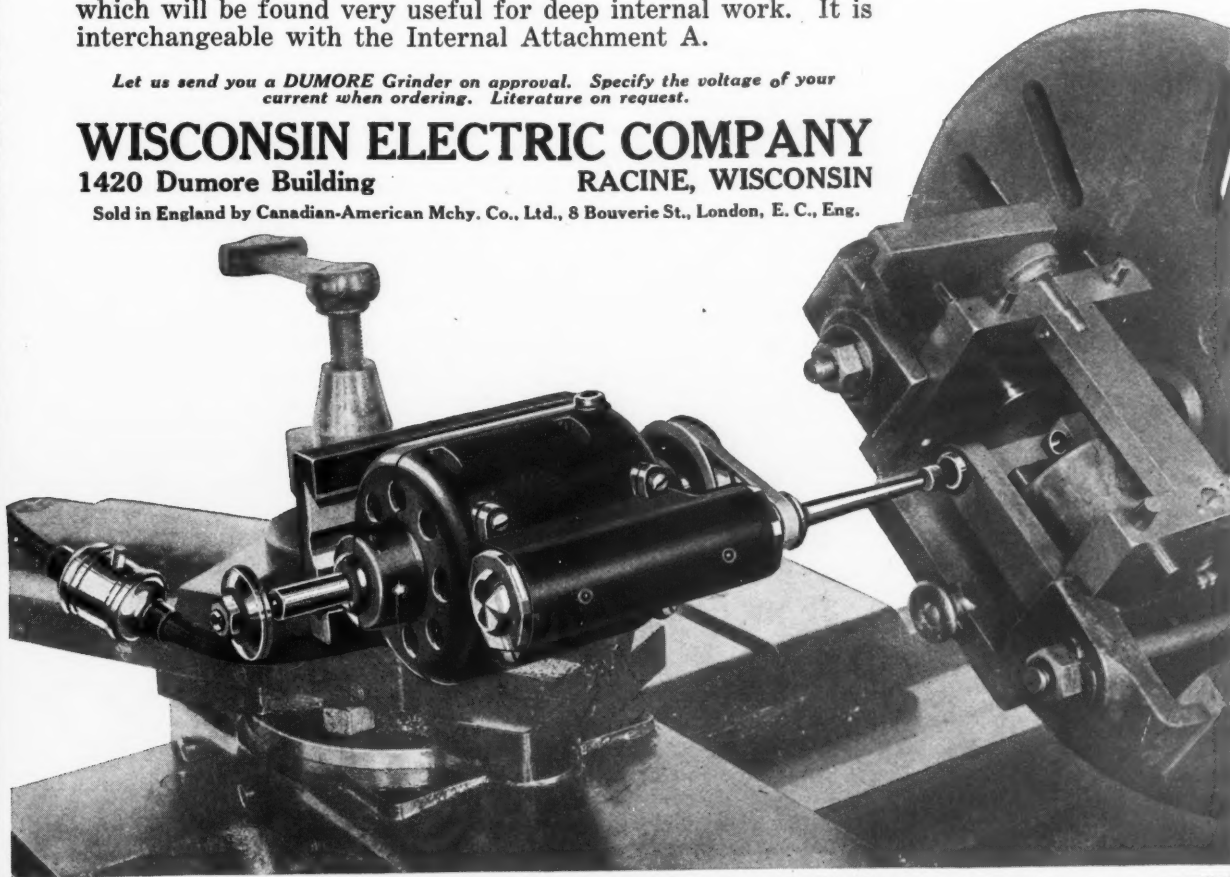
is the ideal tool for grinding dies, gauges and similar work where extreme accuracy is necessary. It is used in hundreds of machine and repair shops for all kinds of grinding jobs. Manufacturers regard it as indispensable for handling the many difficult, hard-to-get-at jobs that continually arise. It will be the most popular tool in your shop.

The high speed at which the DUMORE Grinders operate—10,000 R. P. M. and 30,000 R. P. M.—gives the correct surface speed to wheels of very small diameter. This prevents the wheels from breaking down and your work will be ground accurately and will be entirely free from bell mouth. Equipment A as shown below includes the Internal Attachment A which operates at a speed of 30,000 R. P. M. Equipment B includes the Extension Arm B which has a reach of 10" and which will be found very useful for deep internal work. It is interchangeable with the Internal Attachment A.

Let us send you a DUMORE Grinder on approval. Specify the voltage of your current when ordering. Literature on request.

WISCONSIN ELECTRIC COMPANY
1420 Dumore Building RACINE, WISCONSIN

Sold in England by Canadian-American Mch. Co., Ltd., 8 Bouverie St., London, E. C., Eng.



*A Page From a
Carborundum
Service Man's
Note Book says:*

*"Our Customer Considers
this an Extraordinarily
Good Performance"*

The job is grinding, rough from the sand, chilled iron rolls on a Landis special grinder. The rolls are 32 inches long, $16\frac{7}{16}$ inches in diameter and $\frac{7}{16}$ stock is removed. It takes the Carborundum Wheel, 24 grit, L grade, G 3 + bond just $4\frac{3}{4}$ hours to do the work.

☞ The finish is uniform, the wheel cuts clean and it loses but $\frac{1}{15}$ of an inch.

☞ It is the unbeatable grinding combination that gets these results. —The right wheel, Carborundum service and a good grinding machine.

What can this service do for you?



THE CARBORUNDUM COMPANY
NIAGARA FALLS, N. Y.

NEW YORK CHICAGO PHILADELPHIA CLEVELAND CINCINNATI BOSTON PITTSBURGH
MILWAUKEE GRAND RAPIDS

"INGERSOLL-ROGLER" Class "ER" Power Driven AIR COMPRESSORS

You cannot afford any but a compressor that can be relied upon to deliver the air you need—all the time.

Ingersoll-Rogler Compressors qualify because they have the following features—

"Ingersoll-Rogler" Air Valves—simple, durable and efficient.

Automatic Lubrication—ample at all speeds, economical and cleanly.

Enclosed Construction—excluding dust and dirt.

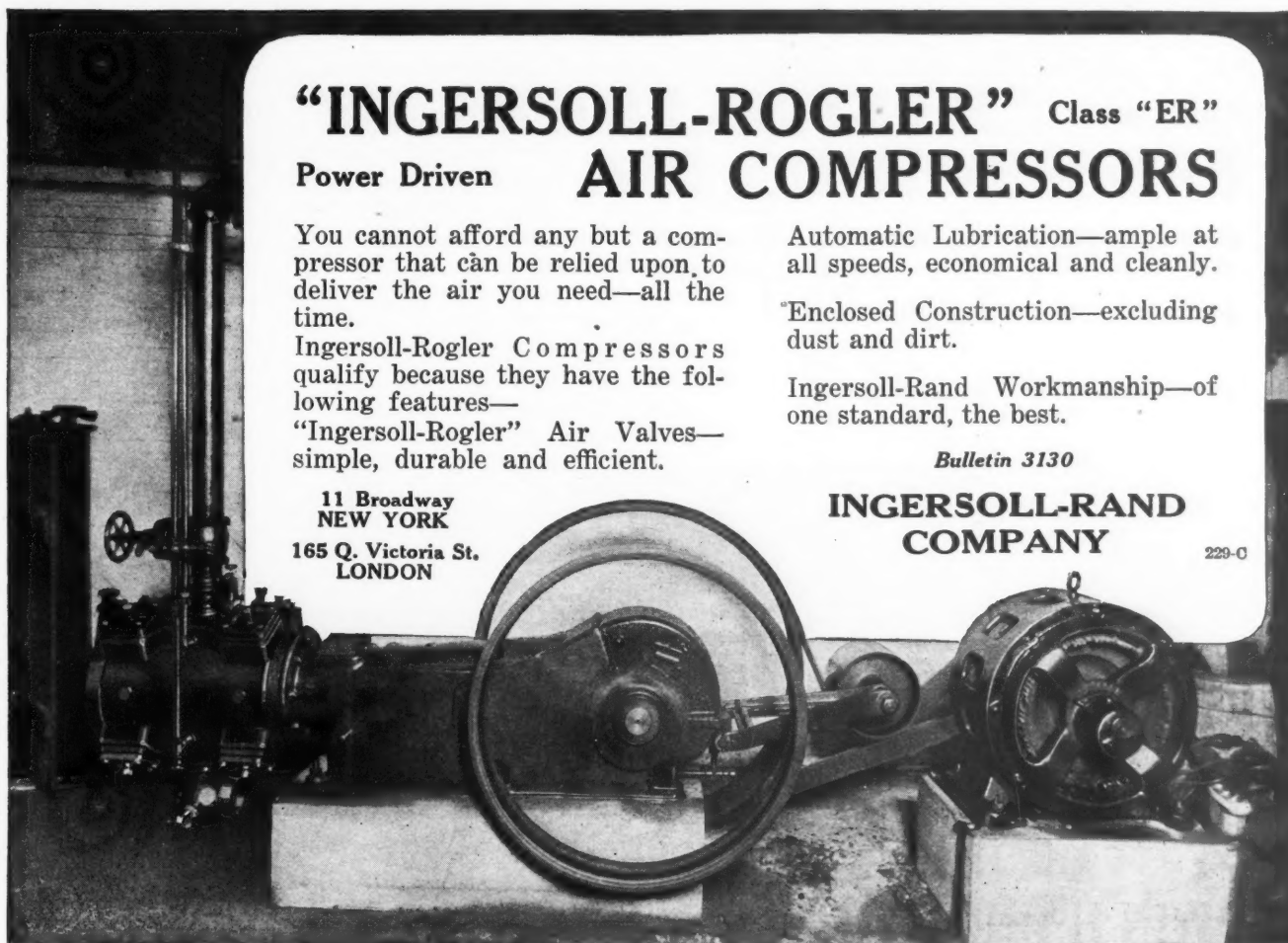
Ingersoll-Rand Workmanship—of one standard, the best.

Bulletin 3130

**INGERSOLL-RAND
COMPANY**

229-C

11 Broadway
NEW YORK
165 Q. Victoria St.
LONDON



For Fast, Heavy Duty Metal Cutting THE RACINE

For cutting Angles, Channels, I-Beams, Die Blocks, Pipe, Tubing, etc., at high speed, this Racine Machine leads the pack. It is equipped with the patent return stroke, automatic lifting device—original with these machines—which means higher output and greater blade economy than is possible with any similar machine of equal capacity. Blades can be tightened without wrenches, saw-frame holds itself automatically at any height, stock can be held firmly at any angle and short lengths cut without trouble.

**RACINE TOOL &
MACHINE CO.**

**250 Fifteenth Street
RACINE WIS., U. S. A.**



Many Sizes

Ask us for further
details of the all-
round metal cutting
saw.

RACINE TOOL & MACHINE CO.
RACINE WIS. U. S. A.
PATENTED JULY 13, 1908.
PATENTED FEB. 24, 1914

**Our Engineers' Foresight
has again Dominated.**

We now show the

HARRINGTON

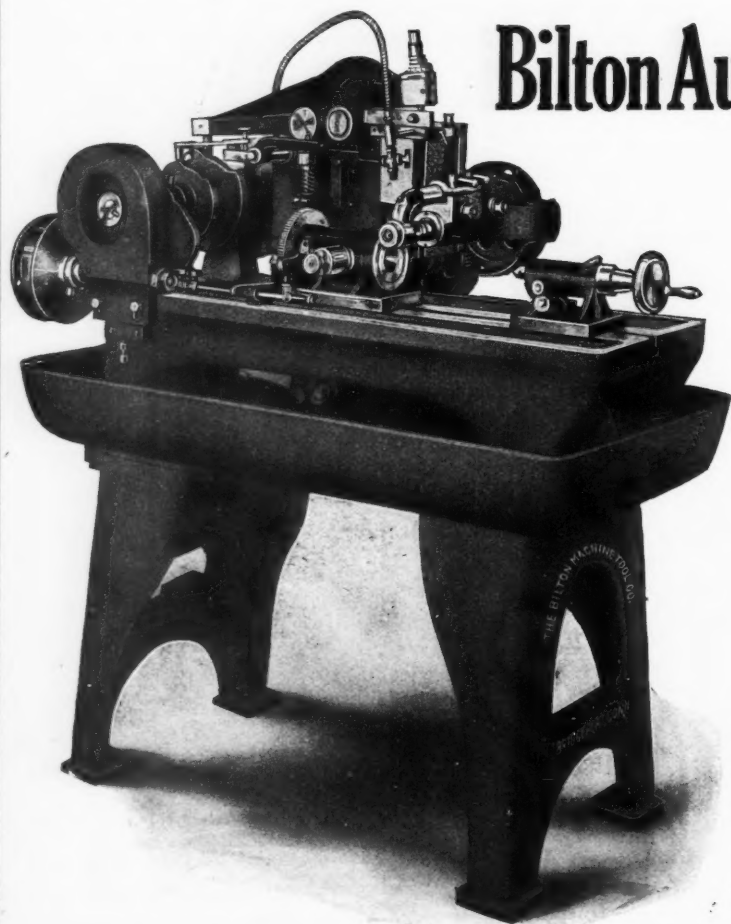
No. 62

For drilling Nozzles, Joints, Unions, Bonnets, Yokes, etc. The drive is unusually powerful with a minimum number of gears and ample use of roller bearings. A compact train of spur gears drives the spindles. Belt drive machines are provided with an eccentric sleeve within the lower cone for slackening the belt when shifting.

The feed has three geared changes by sliding key. A heavy internal gear on the rack pinion shaft reduces the strain of the feed pressure on the worm gear teeth. A quick operating clutch is provided for rapid hand movement of the head.



EDWIN HARRINGTON, SON & CO., Inc., Philadelphia, Pa.



Bilton Automatic Gear Miller

Spur or Bevel Gears

CAPACITY

No. 1½—14 Pitch

No. 2½—10 Pitch

No. 3½—8 Pitch

The Bilton Machine Tool Co.

Succeeding THE STANDARD MFG. CO.

Housatonic Ave., Bridgeport, Conn.

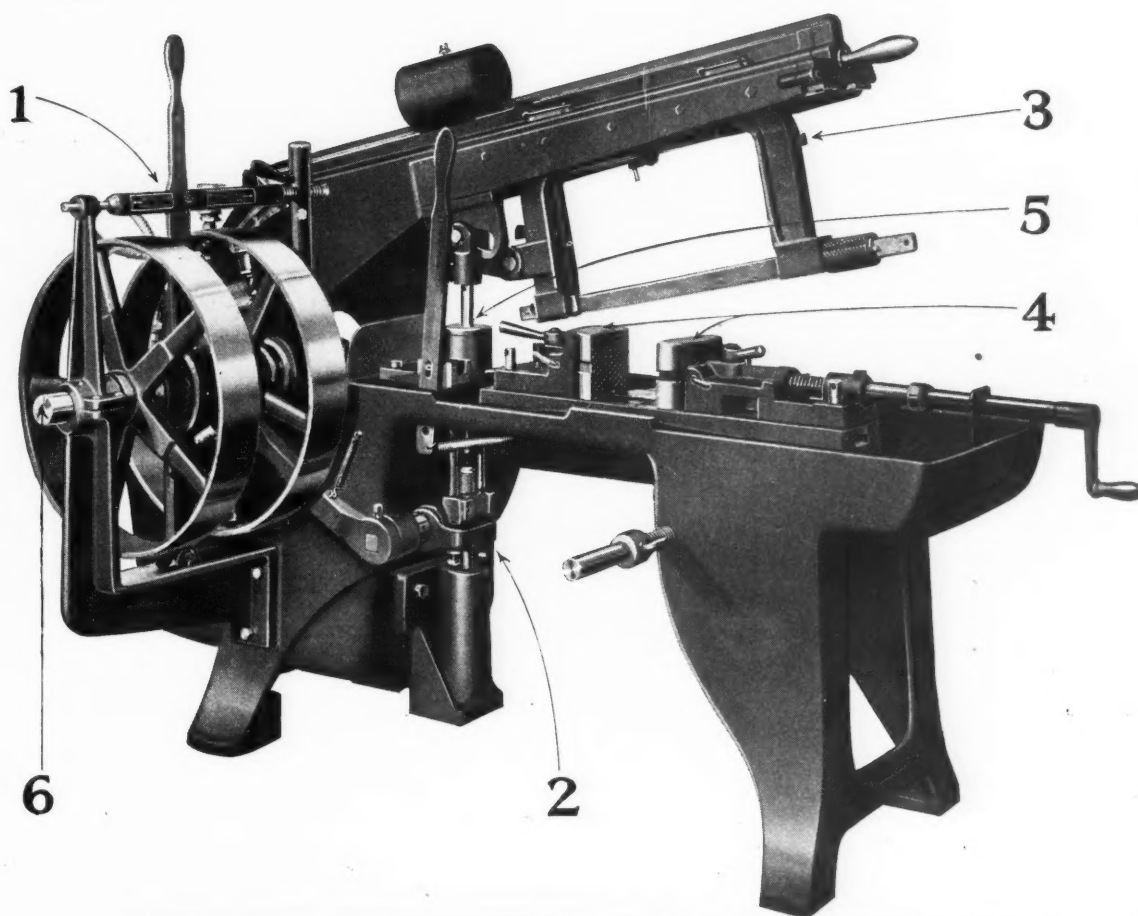
Also Manufacturers of

PLAIN HORIZONTAL MILLERS
AUTOMATIC MILLERS
GEAR HOBGING MACHINES
PLAIN AND BALL BEARING
BENCH AND COLUMN DRILLS
RIVETING MACHINES
MILLING CUTTERS

CATALOGUE 20-G ON REQUEST

FOREIGN AGENTS: Alfred Herbert, Ltd., M. Mett
Engineering Co. Chas. Churchill & Co., Ltd

Distinctive Features of the No. 5 M.S.W. High Speed Hack Saw Machine

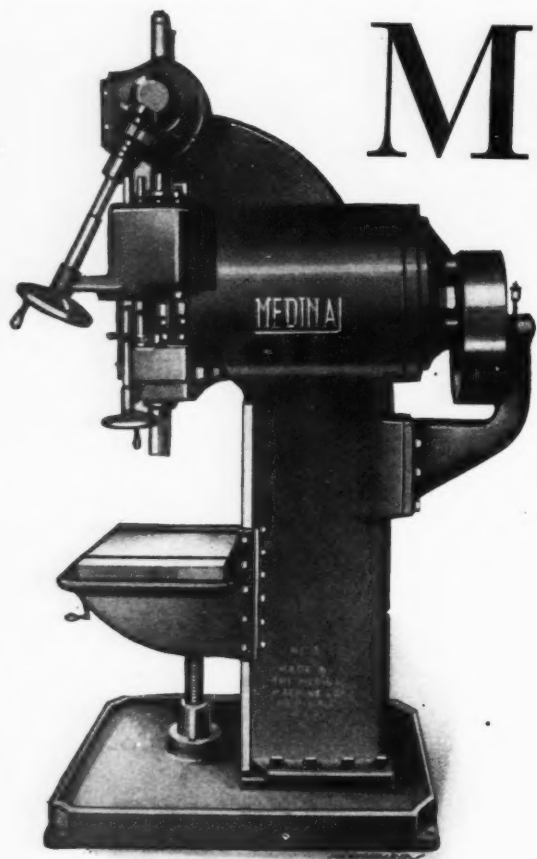


DISTINCTIVE FEATURES

- | | |
|----------------------------------|------------------------------|
| 1. Two Speeds. | 7. Rotary Pump. |
| 2. Shock Absorber. | 8. Knock-off. |
| 3. Extension Frame. | 9. Frame Bearings. |
| 4. Patent Swivel-Jawed Vise. | 10. Tank. |
| 5. Automatic Patent Lift. | 11. Perfect Blade Alignment. |
| 6. Frame Swings on Shaft Center. | 12. Lubricating System. |
| | 13. Draw-Cut. |

For Explanation of these and other features send for Circular

The Massachusetts Saw Works
Springfield,  Mass., U.S.A.



MEDINA

A Powerful Machine for Heavy Manufacturing

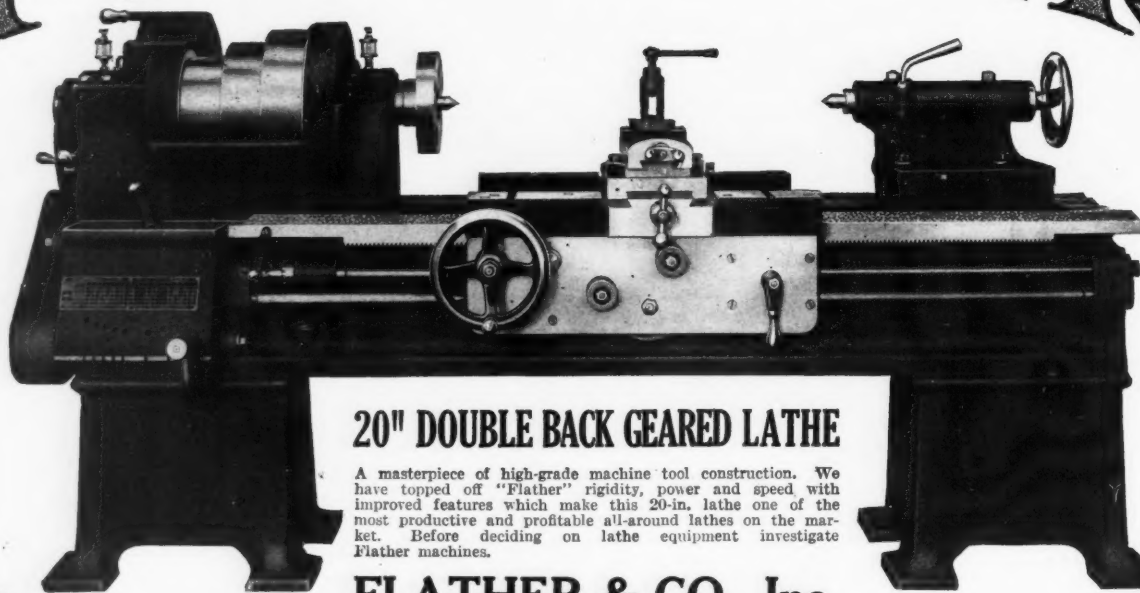
To the experienced man there's evidence of *power* even in appearance, and some of accuracy, too; for the Medina has the proportion and balance and backing-up metal necessary for absolute rigidity. But for the *FULL* facts about the accuracy and output that make Medina Drilling Machines extra efficient for manufacturing purposes, it is necessary to go into detail.

Ask us—even if you're not in the market for drilling machines right now.

MEDINA MACHINE CO.

MEDINA, OHIO, U. S. A.

FLATHER



20" DOUBLE BACK GEARED LATHE

A masterpiece of high-grade machine tool construction. We have topped off "Flather" rigidity, power and speed with improved features which make this 20-in. lathe one of the most productive and profitable all-around lathes on the market. Before deciding on lathe equipment investigate Flather machines.

FLATHER & CO., Inc.

NASHUA, N. H.

LATHES

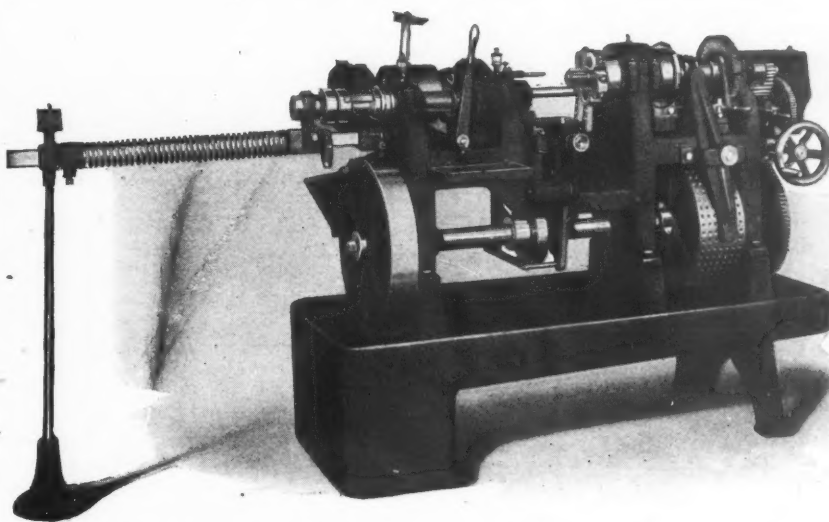
The Chicago Automatic

Built Around the
Cornerstone of
Simplicity

**Chicago Automatic
Machine Company**
Chicago, Illinois, U. S. A.

Eastern Representative

John MacNab Machinery Co.
90 West St., New York
John MacNab, Hyde, England



The Chicago Automatic Screw Machine

owes a great deal of its serviceability to simple design. There are no complicated mechanisms or involved systems of cams to cause trouble; no countershafts and overhead belts to waste power and interfere with additional equipment, spindle speeds suitable for any stock are obtained by changing two gears on the spindle head; threads are cut without slowing spindle speed by means of a die holder revolving in the same direction as the spindle but at higher speed. A clutch mechanism indexes the turret and skips holes not in use. The machine is rigidly built throughout, maintaining alignments and accuracy of work under long, continuous operation.

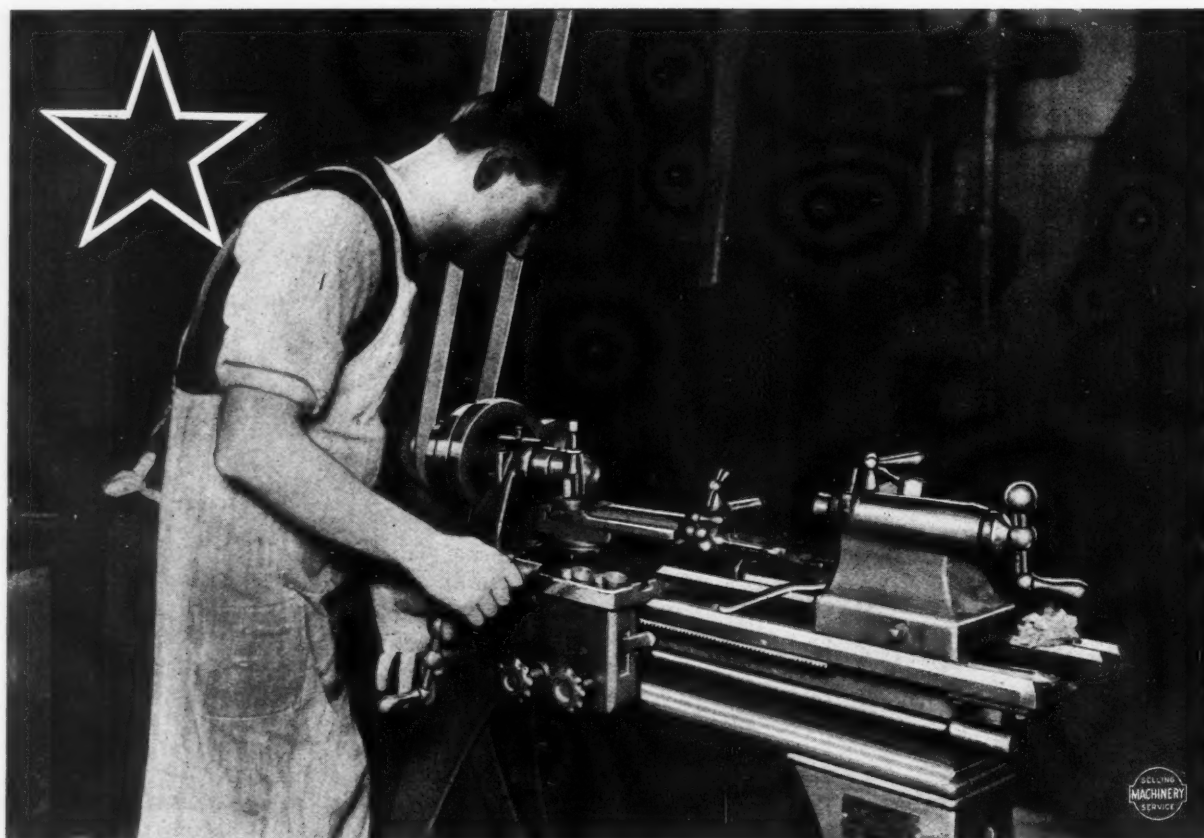
Write for complete description.



Get Acquainted with the New "Filsmith" Lathe

A 13" engine lathe that swings 14" over the bed and takes heavy cuts. The "Filsmith" Lathe is built up on a wide, deep, heavy-walled, box-girded bed, provided with solid, rigid, perfectly aligned headstock, full webbed type, and with tailstock to match. Spindle of 50-point carbon crucible steel, accurately finished by grinding, has bearings of finest grade phosphor bronze. These main features are typical of "Filsmith" construction throughout. Our purpose has been to construct an extra capacity small lathe—accurate, rapid and economical to use. We have succeeded. Let us show you. *Details on request.*

THE PHILIP SMITH MFG. CO., Sidney, Ohio



Another Angle from Which a **STAR LATHE** is a Paying Investment

The "Star" Lathe is a paying investment from any angle, but here's one in particular. In the plant of the Hartford Drop Forge Company, Hartford, Conn., a complete, thread-cutting, small capacity lathe is required for intermittent service. Many lathes are a losing proposition under such conditions; but on account of the low cost compared with others, a Star Lathe need not be run all the time to insure proper returns on the investment. It is an ideal lathe for requirements of this kind. Accuracy of construction and operation is second to none, and with taper attachment incorporated it handles a considerable range of work with efficiency not exceeded by lathes at double the cost.

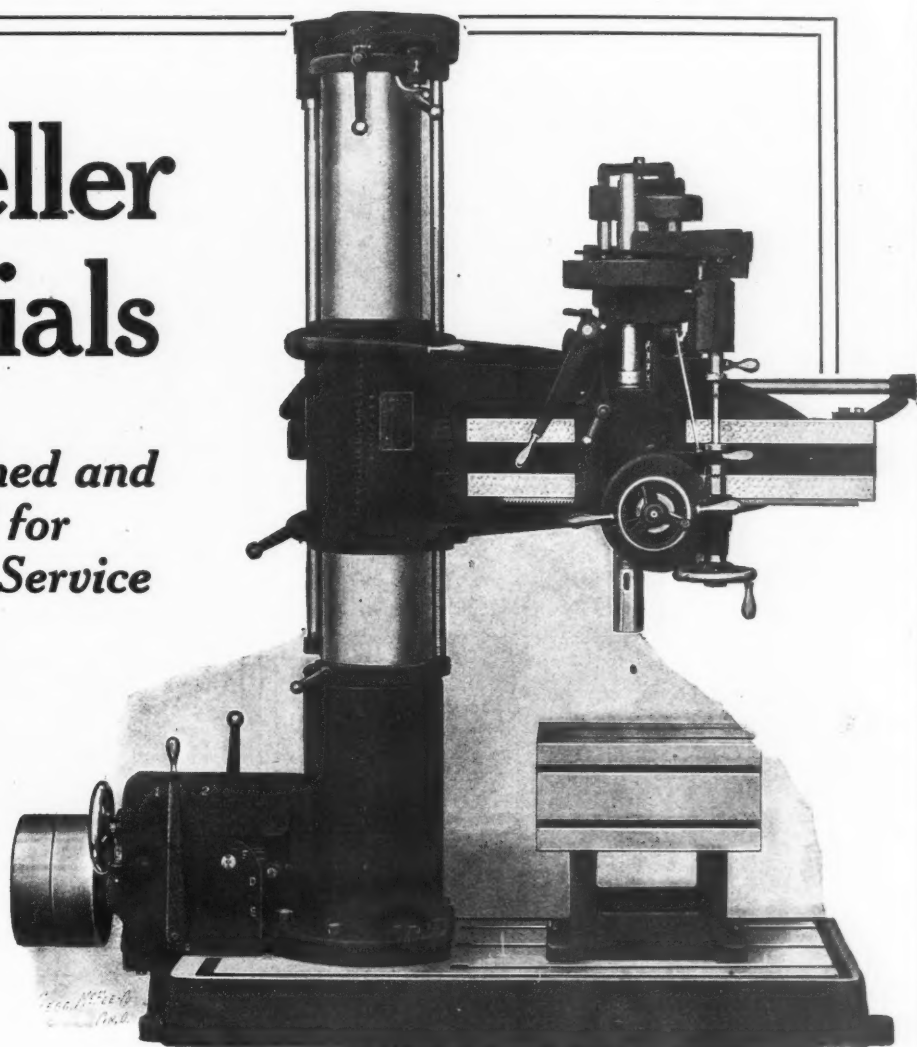
If you have work of this character you need the "Star"; if you have tool room work sufficient to keep a lathe busy all the time, it's still unquestionably the lathe to buy.

Write for catalogue for descriptions of the line.

SENECA FALLS MANUFACTURING CO.
330 FALL STREET SENECA FALLS, N. Y.

Mueller Radials

*Examined and
Passed for
Active Service*



Mueller Radial Drills have been thoroughly examined, tried and tested under ordinary and unusual conditions and are admitted to be in every way qualified for any service they may be called upon to perform.

Material, reinforcement and design of the best.

Speeds, feeds and ranges, many and varied.

Controls, in every case simple, convenient and rapid. *Ask for details.*

THE MUELLER MACHINE TOOL CO.

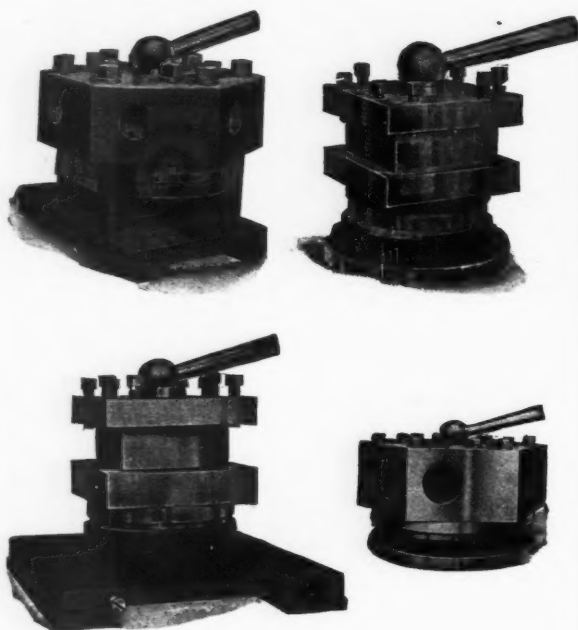
CINCINNATI, OHIO, U. S. A.

RADIALS

DRILLS

LATHES

PHOENIX Turret Attachments



A Necessity in the Modern Shop

Phoenix Attachments are adapted for a multitude of lathe operations that ordinarily require special tools; being particularly well fitted for handling economically, the "shortjobs" so difficult for either turret or engine lathe.

It is an easy matter to attach them to the cross slide of any engine lathe; they are perfectly rigid when set up, extremely easy to use, and are readily released by a three-quarter turn of the handle.

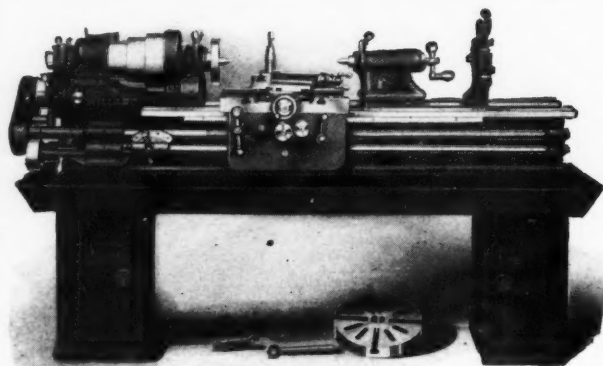
If you'd like to get 100% efficiency from your engine lathes, you'll want to know more about them.

Complete description on request.

PHOENIX MANUFACTURING CO.
EAU CLAIRE WISCONSIN

CLEVELAND OFFICE: 1430 WEST 6th STREET

The WILLARD 13" Engine Lathe



FITTED with cabinet legs and pan base, is especially adapted for tool room and school purposes. Extra powerful drive permits handling work beyond the ordinary small lathe range. Convenient operation makes for speed. Rigid construction insures uniform accuracy. The "Willard" swings full 13", has complete range of feeds, stands hard driving, is complete in every detail.

We should like to tell you more about these exceptional machines. May we?

The Willard Machine Tool Co.
CINCINNATI OHIO, U. S. A.

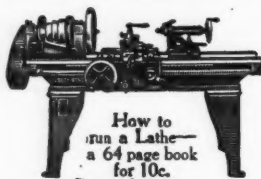
W & P PLANERS

Planers with rigidity, strength and power to meet the heaviest demands.

We build rapid, accurate, long service planers of every type, know planer requirements from A to Z, and will be glad to help you pick the machine best suited to your work.

Write for particulars.

WOODWARD & POWELL PLANER CO.
WORCESTER MASS., U. S. A.



How to
run a Lathe—
a 64 page book
for 10c.
Postpaid, coin or
stamps.

SOUTH BEND LATHES For the Machine and Repair Shop

A Practical Lathe at Low Price. 11-inch to 18-inch Swing. Straight or Gap Beds. Send for free catalog.
SOUTH BEND LATHE WORKS
426 E. Madison St., South Bend, Ind.

ENGINE LATHES

18' to 48' Swing

THE BOYE & EMMES MACHINE TOOL CO.
Cincinnati, Ohio

USERS OF THE LATHE WITH THE PULL

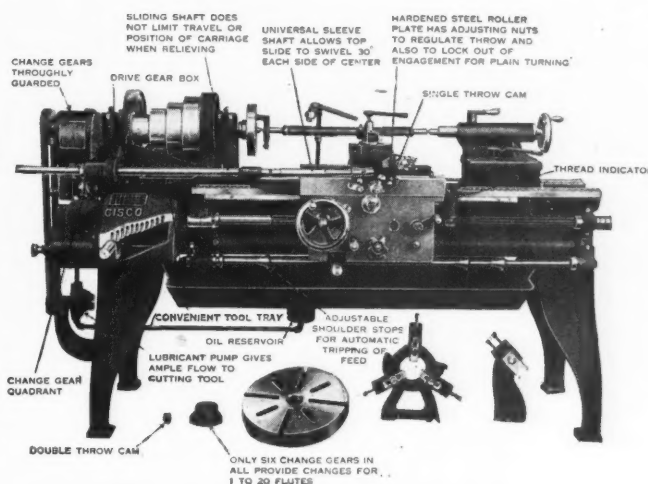
PLEASE NOTE

We find that we have been selling

CISCO Lathes

underweight.

That every lathe manufactured weighs about 200 pounds more than the published weight.



You have been getting your money's worth and always will. Better and better all the time

**That's
CISCO**

BETTER BUY CISCO

Made in 14", 16", 18", 24" sizes

THE CINCINNATI IRON & STEEL COMPANY, CINCINNATI, U. S. A.

Harron, Rickard & McCone, San Francisco and Los Angeles. A. R. Williams Mch. Co., Ltd., Winnipeg, St. Johns, Toronto, Montreal and Vancouver, Can. Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo. Young, Corley & Dolan, Inc., New York, N. Y. Knight & Wall Co., Tampa, Fla. McArdle, New Orleans, La. R. L. Scrutton & Co., Sydney, N. S. W. Perine Machinery Co., Seattle, Wash. W. F. Davis Machine Tool Co., Cleveland, O. Laughlin-Barney Mch. Co., Pittsburgh, Pa. Southern Mch. Exchange, Jacksonville, Fla. J. L. Lindsay, Richmond, Va. Stratton & Bragg Co., Petersburg, Va. Manufacturers Selling Agency, Birmingham, Ala. Marshall & Husehart Mch. Co., St. Louis, Mo. C. E. Fales Mch. Co., Detroit, Mich. S. R. Meisenbeler Mch. Co., Philadelphia, Pa. Purinton & Smith, Hartford, Conn. H. A. Smith Mch. Co., Syracuse, N. Y. Herbert R. Lowe, Providence, R. I. Badger-Packard Mch. Co., Milwaukee, Wis. Dale-Brewster Mch. Co., Chicago, Ill. Thompson Tool and Supply Co., Indianapolis, Ind. John MacNab, Hyde, England. Grimaldi & Co., Genoa, Italy. A. J. Coccaro & Co. (New York) for France and Spain. Chinese-American Products Exchange Co. (New York) for China.

"PREPAREDNESS —versus— RISING COSTS"



Send
for
bulletin
B-602

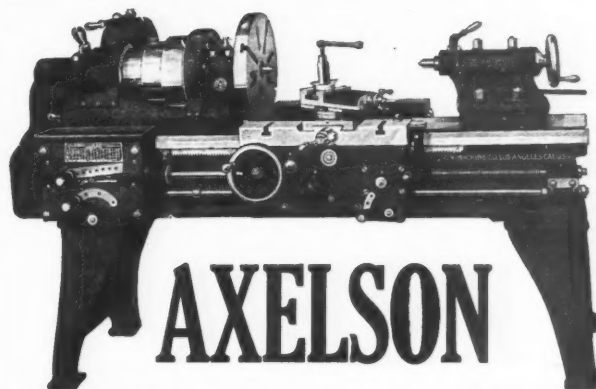
Are you prepared to make those small parts the most economical way—the Dalton way?

With a "Dalton Six" Type B-4 as part of your shop equipment, is to be prepared to combat your most powerful enemy, "Rising Costs."

Add a "Dalton Six" to your battery of machinery. You will then be prepared to meet the enemy.

Dalton Manufacturing Corporation

1911-15 Park Ave. New York, U. S. A.



AXELSON
HEAVY DUTY LATHES
ALWAYS SATISFY

BECAUSE they are the very best lathes for ALL-AROUND work—very best in every sense: Quality of Material, Workmanship, Accuracy, Rigidity and numerous other qualities.

Literature
sent upon
request.

You cannot buy a better lathe. Scores of satisfied owners of AXELSON LATHES are our best arguments. Better investigate.

AXELSON MACHINE CO.

Dept. B

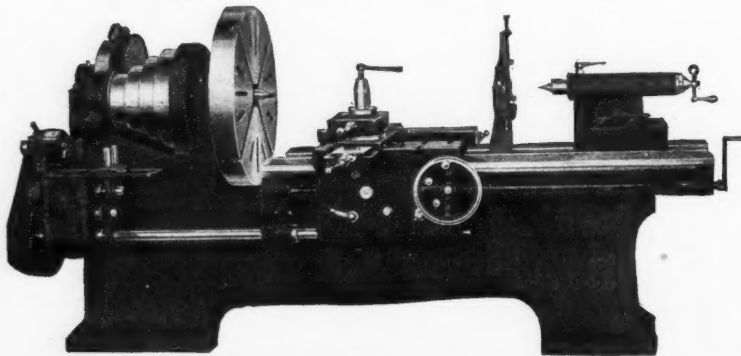
LOS ANGELES, CAL.

Two Lathes in One at a Great Saving in Cost—22-36" Gap Lathe

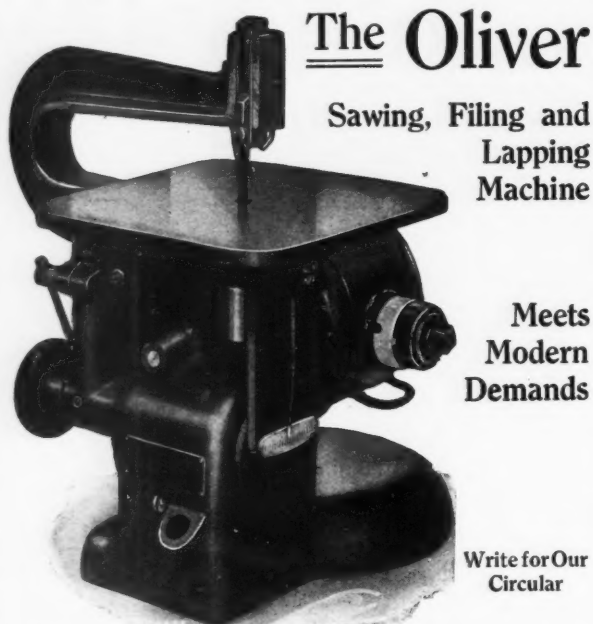
Our Heavy Duty Sliding Extension Gap Lathe is a most necessary tool to the shop with a wide range of work. Being practically two lathes in one, it is sure to be kept busy all the time.

This lathe has main and sliding beds, very heavy and broad. They are braced over their entire length. The lathe loses none of the accuracy and rigidity of the usual type lathe. It is equipped with powerful back gears—has 6 quick changes of geared feeds, 12 spindle speeds and cuts threads 2 to 30—all steel gears throughout.

Let us send full details in Bulletin "M."



BARNES DRILL COMPANY, Inc., 814 Chestnut Street, Rockford, Ill., U. S. A.



The Oliver

Sawing, Filing and
Lapping
Machine

Meets
Modern
Demands

Write for Our
Circular

The order of the day calls for the "latest models." Machines must be changed frequently to meet this demand—new parts must be designed, new patterns made. There is no time for the handmade dies of yesterday—yet the work must be just as accurate, just as well finished.

The OLIVER FILING AND LAPPING MACHINE is the solution of the skilled patternmaker's problem. He can devote all his time to planning and designing new parts while an ordinary mechanic cuts and finishes them in 30 to 60 per cent less time with the "Oliver."

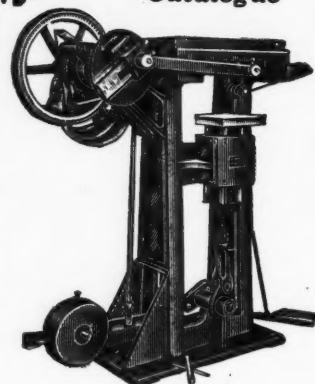
Oliver Instrument Company
ADRIAN, MICHIGAN

DWIGHT SLATE MARKING MACHINE

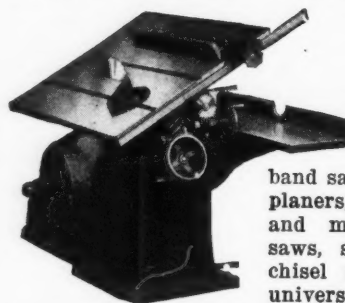
Send for
Catalogue

Trade Marks, Letters
or Numbers put on
your work at RE-
DUCED COST with
quality improved by
these machines. Let-
tering Dies cut by EX-
PERT ENGRAVERS.

Noble & Westbrook Mfg. Co.
Hartford, Conn. U. S. A.

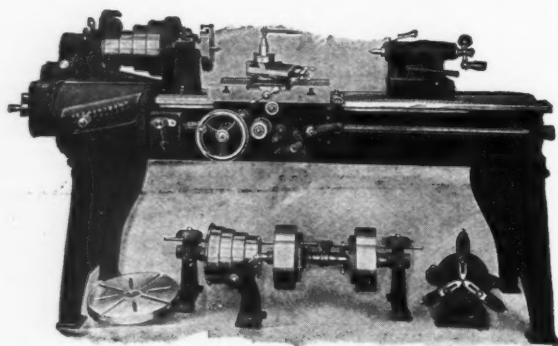


Crescent Wood Working Machinery



will satisfy those particular buyers who want enduring service in wood working equipment. Ask today for catalog telling about our line of band saws, jointers, saw tables, planers, disk grinders, planers and matchers, swing cut-off saws, shapers, borers, hollow chisel mortisers, variety and universal wood workers.

THE CRESCENT MACHINE CO.
56 MAIN STREET LEETONIA, OHIO



Read Our Specifications

Before going ahead get a copy of our specifications of this 14" engine lathe. It's a

CARROLL-JAMIESON Screw Cutting Lathe

It has double back gears, quick-change gears giving thirty-two changes of feed without removing a gear, nine spindle speeds, 2½" belt drive from three-step cone.

Drop a line now for a set of specifications.

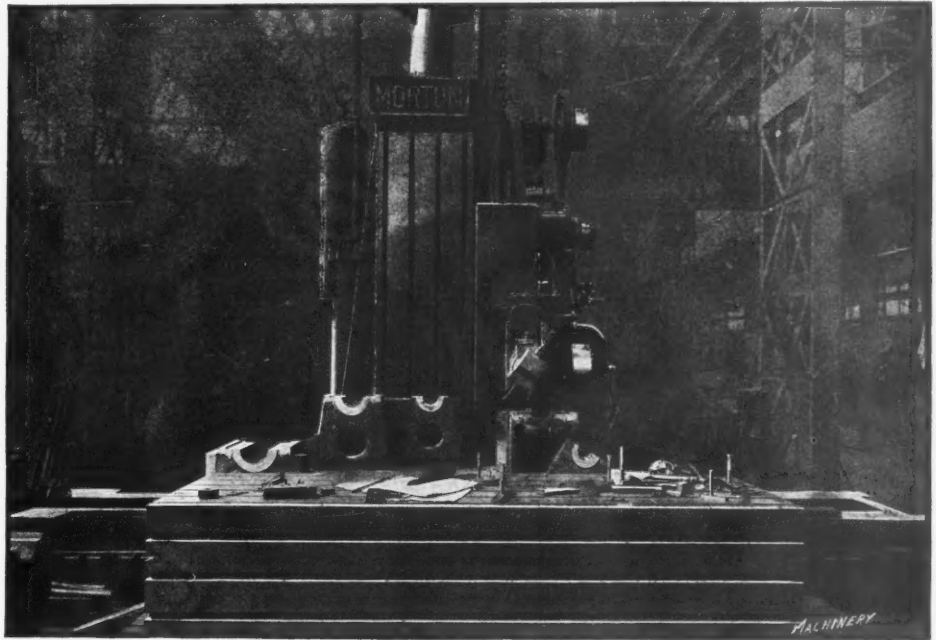
THE CARROLL-JAMIESON MACHINE TOOL CO., 257 Davis St., Batavia, Ohio

The Morton Draw-Cut Traveling Head Planer

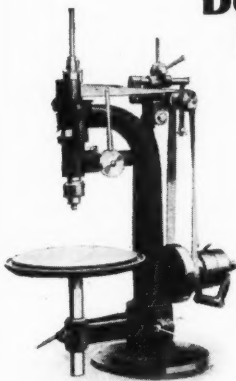
*Unequaled
for Manufac-
turing or
General Shop
Work*

**MORTON
MFG.
COMPANY**
Muskegon Heights
MICHIGAN

THE remarkable adaptability of Morton Planers makes them profitable machines in any shop. Their range is practically unlimited. They are ideal for general requirements, and so simply designed and flexible that they can be readily adapted for any special work. Compared with the housed planer, the Morton requires but half the floor space and one-fourth the power, may be used either as a portable or a stationary machine, can be reversed into a push cut planer if desired, and handles all boring and milling easily and accurately regardless of the size of the piece. Convenient, powerful—and needed in most shops. *Send for Bulletin 8D.*



Demco High Speed Drilling Machine

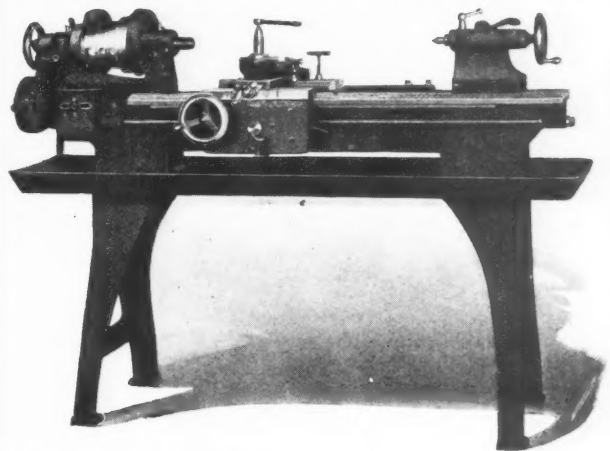


Our new machine's maximum speed is 12,000 R. P. M. Drives 3/16" to 3/8" drills at proportionately slower speed. Ball bearings are used throughout; high carbon, heat treated, accurately ground spindle has 3-jaw geared nut chuck of key type; three speed changes by simply moving a lever. We have built a sturdy, high-grade small-hole drilling machine, bench or floor type, that not only increases output but minimizes drill breakage—a marvel of speed and accuracy. Furnished with either square or round table.

Write for full description.

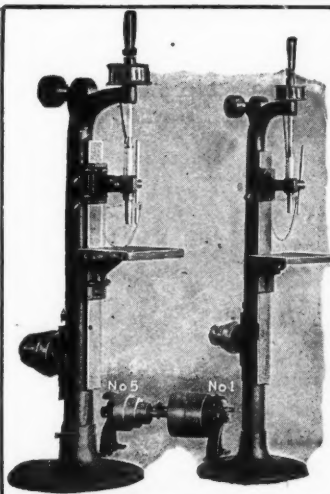
THE DE MOOY MACHINE CO.
706 Frankfort Ave., Cleveland, O.

Worcester 11" Tool Room Lathe



This simply designed, steady-going, efficient machine is built along the same general lines of our Standard 11" Lathe, with the addition of Steel Pan, Taper Attachment and Draw-in-chuck. The Taper Attachment is graduated and can be easily set for turning; Draw-in-chuck operates by means of a closer and split collet of tool steel, hardened and ground. The lathe swings 12 3/4" over bed, 8" over carriage, cuts threads from 2 to 40, takes turning tools 1/2" x 1". *Write for further details.*

WORCESTER LATHE COMPANY
68 Prescott St. WORCESTER, MASS.



No. 1 Drill—14"
265 lbs., Capacity 1/2"

No. 5 Drill—16"
430 lbs., Capacity 3/4"

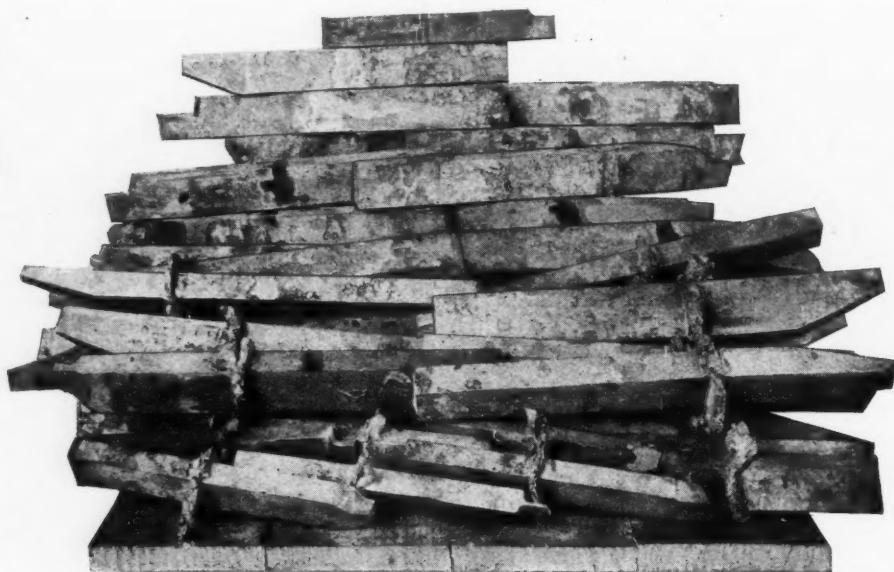
A splendid line of single
spindledrillingmachines.

Manufactured by
FRANCIS REED CO.
43 Hammond Street
Worcester, Mass.

700 ELWELD TOOLS

For One Concern

*That Would
Indicate They
Were Good Tools
Wouldn't It?*



These 700 tools were made from so-called scrap—short pieces of high speed steel that could no longer be used to advantage in the usual manner. We Elwelded these pieces to tool steel shanks, conforming to sizes designated, and 700 new high speed tools resulted at a fraction of their first cost. Compare this cost with that of new tools and it'll be an eye-opener.

And don't overlook the significance of the repeat orders we've had from these people. The fact that they've come back again and again for more Elweld tools surely proves that they're saving money and we're giving satisfaction.

Let us show you a sample of our work. We're increasing our capacity again and can give your specifications prompt attention. Any tools from 11½" x 2½" down to ½" x 1".

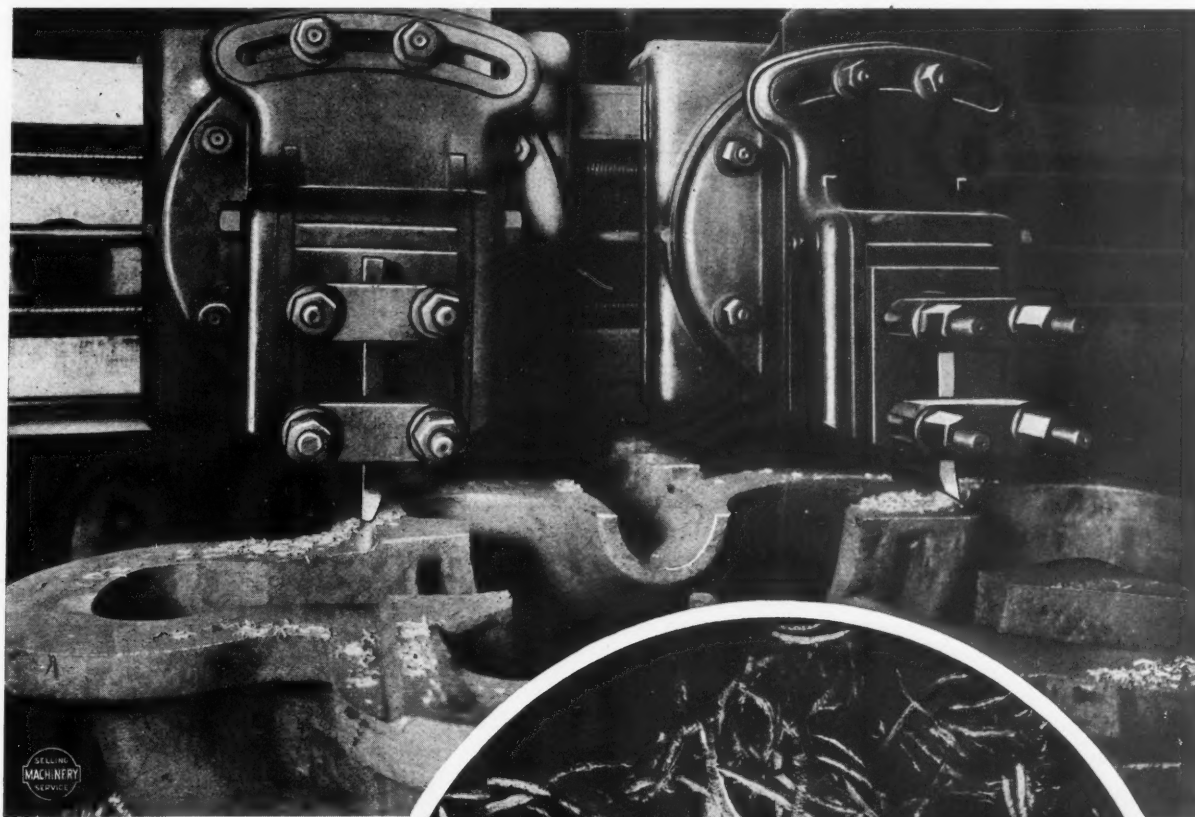
**We do commercial butt welding also,
large or small, and will be glad to
figure with you.**

The Electric Welding Co.

(Superior Viaduct)

Cleveland

Ohio



These are
**High Speed
Steel Tools**

*Would You
Believe it?*

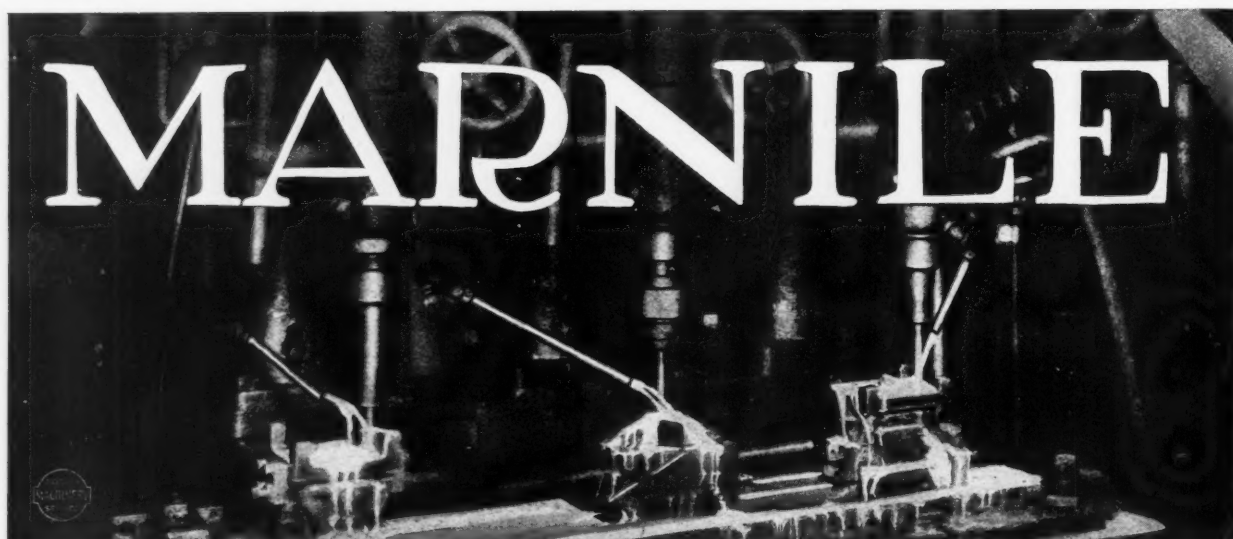
This job is typical of
some of the work put
up to Uranium tools.

These two pump casing castings are made of acid-proof bronze, an exceptionally tough metal to cut; the chips shown are full size and indicate how short the metal flakes under the cutting action. Uranium steel tools are the only tools that stood up under this work.

You, no doubt, often meet just such tough planing or turning propositions and then you need Uranium for best results.

*Your own steel man can tell you about
Uranium High Speed Steel; if not, consult us*

Standard Alloys Company
Forbes & Meyran Avenues PITTSBURGH, PA.



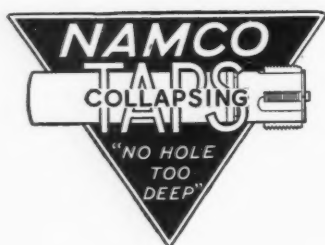
A Good Compound for Tough Drilling

The machine is a Prentice Drill Press, the work is chromium high-carbon steel thrust bearing washers—"tough old birds," the operator said—but the cutting compound is Marnile. So the drills cut clean and cool, don't tear the holes, and stand up 25 per cent longer between grinds than when oil or soda water was used. Output is 25 per cent greater and lubricant bills are 75 per cent lower. Interesting and profitable results, aren't they?

Let us send a sample of Marnile to prove similar results on your work.

GEORGE A. HAWS, Inc., 135 Front St., New York, N. Y.

Reducing the Thread Cutting Costs



The New NAMCO Positive Collapsing Tap offers an immediate solution to this high threading cost problem.

The NAMCO Tap differs from all other collapsible taps both in design and construction and features many advantages over the old style of tap, namely

- capacity for any depth hole.
- positive collapsing action.
- proper support for chasers while cutting.
- all operating mechanism within body.

The new catalog explaining in detail the reasons for the improvements claimed for NAMCO Collapsible Taps will be sent on request. Ask for NAMCO Tap Catalog "B."

(Capacities 1/4 inch up)

THE NATIONAL ACME COMPANY, CLEVELAND, OHIO

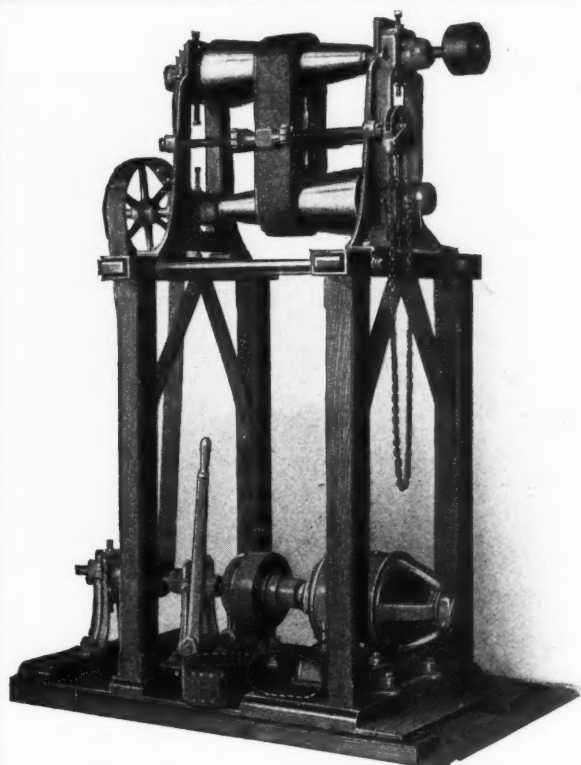
New England Plant: Windsor, Vermont

Canadian Plant: Montreal, P. Q.

BRANCH OFFICES—NEW YORK BOSTON CHICAGO DETROIT
ATLANTA, SAN FRANCISCO. REPRESENTATIVES IN FOREIGN COUNTRIES

Makers of Gridley Single and Multiple Spindle Automatics at Windsor, Vermont; and Acme Automatics, Threading Dies, and Screw Machine Products at Cleveland, Ohio





Constant Speed Alternating Current Electric Motor, combined with Moore & White Speed Change giving variable speed, and Moore & White High-Speed Friction Clutch for starting under load.

Speed Regulation with Alternating Current Motors

The Moore & White Speed Change permits the drive from an A. C. motor to be varied in speed as freely as when D. C. motors are used.

By its use, lathes, boring machines, and machinery for pumping, conveying, bleaching, drying, textile manufacture, etc., can be made to operate at maximum efficiency all the time, thereby overcoming the chief drawback to the use of alternating current.

MOORE & WHITE SPEED CHANGES

operate **without frictional slip.** Their special feature is the use of a pair of flexible "transformers," one on each cone, in which tapering strips build the cone up to cylindrical form. Each strip acts like part of the cones while in contact with it. It is not necessary to use a narrow belt.

Owing to the absence of slip, the speed control is very exact. Taken with the inherent steadiness of A. C. motors, this is a very valuable feature for many classes of work demanding accurate speed regulation.

We furnish the complete Speed Change in vertical and horizontal form in sizes from 1 to 200 H.P.

To manufacturers wishing to incorporate the Speed Change in their own machines we sell the patented transformers separately.

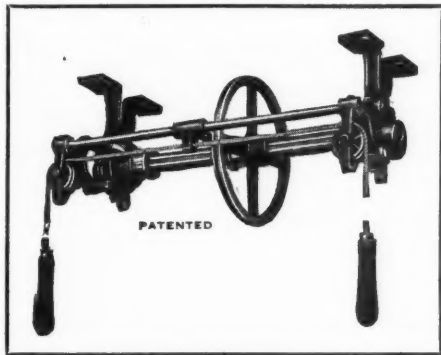
Write for booklet, "Speed Changes without Frictional Slip," giving full particulars of sizes and styles.

THE MOORE & WHITE COMPANY, 2707 to 2737 N. 15th St. PHILADELPHIA, PA.

Makers also of Moore & White Standard and High Speed Friction Clutches

NEW ENGLAND REPRESENTATIVE: Gilbert Howe Gleason, 141 Milk Street, Boston, Mass.

COUNTERSHAFT FOR GRINDER WORK



"DALTON" (Patented) Grinder Counter-shaft is designed for use on small lathes of all makes, using either internal or external grinding attachments.

The hangers are universal in adjustment for use upon either ceiling or wall.

Manufactured only by the makers of the "DALTON SIX" Lathe.

Send for Bulletin.

Dalton Manufacturing Corporation
1911 PARK AVE, NEW YORK, U. S. A.

REAL FLEXIBILITY

in connecting the shafts of any two close coupled machines eliminates the expense of extremely careful alignment, and provides for the misalignment which causes trouble and expense when rigid couplings are used.



Francke Flexible Couplings

are flexible in three directions in addition to providing a cushion for the driving shocks. For any size and type of direct power drive. Send for descriptive literature.

Over a million horsepower in service

SMITH-SERRELL CO., Inc.
General Sales Agent for THE FRANCKE COMPANY
144-B Cedar St., NEW YORK CITY

FORD TRIBLOC



The Chain Hoist in the Foreground of Service

They say you can always tell whether a picture of a street scene is real by looking for the Fords. The same is true of shop scenes—only in this case the Fords are Ford Tribloc Chain Hoists. Manufactured, marketed and guaranteed for five years by Ford of Philadelphia.

Ask for Catalog.

FORD CHAIN BLOCK & MFG. CO.

137 Oxford Street

PHILADELPHIA, PA.

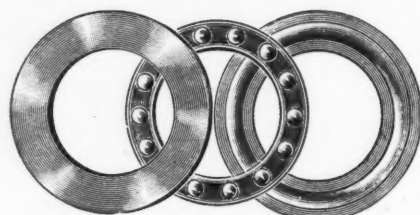
2090-D.



THE BEARINGS COMPANY OF AMERICA

LANCASTER PA., U. S. A.

Western Office:
604 Ford Bldg.
Detroit, MICH.

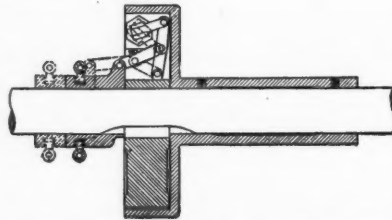
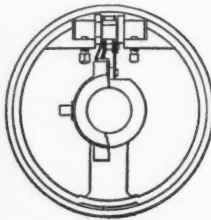


COMPLETE THRUST BEARING

Manufacturers of Ball Retainers for Cup and Cone, Thrust and Magneto Type Bearings.



*Write
for List of
Sizes*



BROWN CLUTCHES

are guaranteed to deliver their true rated horsepower. Our line runs up to 150 horsepower.

SEND FOR CATALOG AND PRICES

THE BROWN CLUTCH COMPANY
1005 CAMP STREET SANDUSKY, OHIO

"THE CHAIN OF DOUBLE LIFE"
Fits Out and Standard C. I.
Sprockets—1 to 12 in. pitch.

Union Steel Rivetless Chains

High Carbon Links (STRENGTH), Large Glass-hard Reversible Bearings (DURABILITY), One-piece Rivetless Construction (PERMANENCY) insure TROUBLE-PROOF, MONEY-SAVING SERVICE. Bushing Chains, Roller Chains, Sprockets, Buckets, Elevators, Conveyors, etc.

The Union Chain & Manufacturing Company, Seville, Ohio
30 Church Street, New York Telephone, Cortlandt 892

New Patent WHIP-HOISTS

and Elevators with Governor Safety

Also Patent Friction Clutches and Pulleys

VOLNEY W. MASON & CO., INC.

Providence R. I., U. S. A.

WRIGHT HOISTS

The hand hoist is an important link in a conveying system. It is an integral part of a trolley system; an accessory that is practically indispensable for loading or unloading of various kinds; a portable outfit that can be taken wherever it may be needed, for all manner of miscellaneous hoisting. Wright Hoists are built for hard, continuous service, and we claim they'll both outlift and outlast any other chain hoist on the market. Catalog A-16.

**WRIGHT MANUFACTURING
COMPANY**

LISBON

OHIO, U.S.A.

The Incapable Hoist Operator



A man who is tired is incapable of performing any kind of duty. His mental efficiency is dulled and his energy gone.

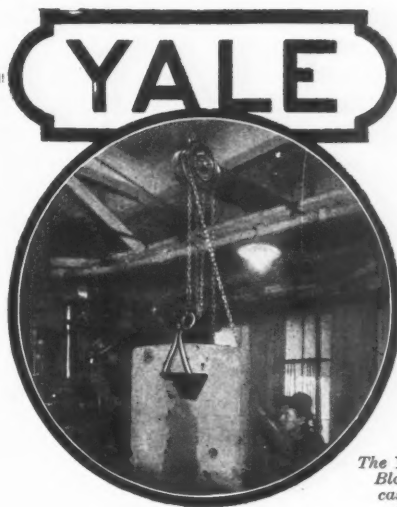
THE PEERLESS HOIST

is not burdensome or a back-breaker. The ease of operation is perfect. Only easy pulling is required to raise and lower the load. Absolute safety is assured by

**Steel Hangers
Steel Hooks
Steel Swivels
Steel Load Wheels
Steel Gears**

No cast or malleable iron parts used to carry the load.

EDWIN HARRINGTON, SON & CO., Inc.
PHILADELPHIA, PA.



*The Yale Triples
Block setting
casting in a
machine.*

The name "Yale" on a chain hoist

means more to the buyer than a mark of identification. It is, above all, a visible guarantee of service and quality—a guarantee of superiority in design, materials and workmanship.

This visible guarantee on the Yale Triples Block rests upon the conclusive tests of the materials entering into its construction; the careful machining and assembling of the parts; and finally the working test of 3360 pounds for each rated ton.

Put your hoisting problems up to us

For factory locking equipment use a Yale Master-key System. Write us for particulars.

The Yale & Towne Mfg. Company
9 East 40th Street New York City

Cranes and Hoists

Electric Traveling
Cranes.
Hand Power Travel-
ing Cranes.
Bucket Cranes.
Jib Cranes.
Monorail Cranes.
Electric Hoists.
I-beam Trolleys.
Track Systems.
High Speed Chain
Hoists.

Alfred Box & Co.
PHILADELPHIA, PA.



Did you ever stop to realize what a big advantage that machine manufacturer has who can order his duplicate clutch parts by number?

Conway Patent Friction Clutches have other remarkable features.

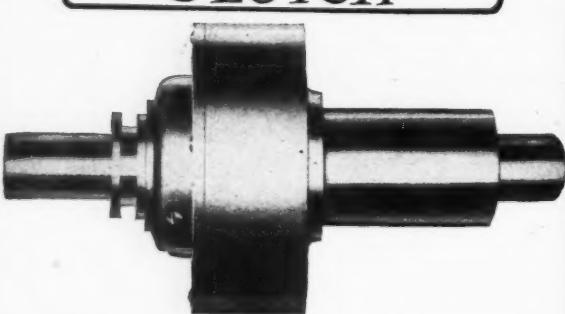
CONWAY & COMPANY

FAIRMOUNT, CINCINNATI

Manufacturers of Friction Clutches Since 1895

CLEVELAND

The Dependable
CLUTCH



A SIMPLE, POWERFUL FRICTION CLUTCH

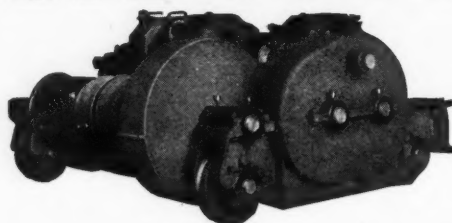
which can be modified to meet any clutch requirement. The "Cleveland" has no complicated parts to give trouble, nothing to get out of adjustment, engages smoothly, operates safely, releases instantly. If you want the ultimate in dependable clutch service buy a "Cleveland." Clutches up to 270 H. P.

WRITE FOR CATALOG C

THE RELIANCE GAUGE COLUMN COMPANY

6008 Carnegie Avenue, Cleveland, Ohio

NORTHERN CRANES



Has your crane a modern ship-shape safety trolley like this? This is our

"Type E" Crane Trolley

Made along up-to-the-present lines with all features of safety and efficiency demanded by good engineering practice. Learn more—get our catalogs. We also make



ELECTRIC HOISTS

Air Hoists, Foundry Equipment, etc.

Northern Engineering Works
6 Chene Street Detroit, Mich.

"TOLEDO CRANES"

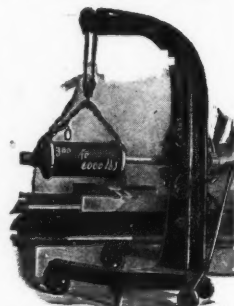
FOR EVERY SERVICE

**They are quite
Reliable**

The Toledo Bridge & Crane Co.
2950 Dorr St. TOLEDO, OHIO

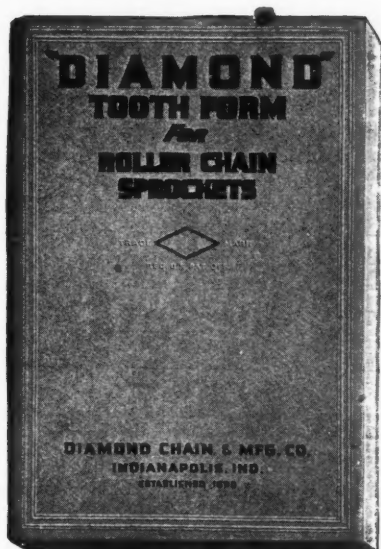
It's So Easy with a "Canton"

The lifting that taxes half a dozen strong workmen and causes their machines to stand idle, can be handled easily by one man if there's a Canton Portable Floor Crane handy. It's a real necessity in any shop, big or little; the convenience, economy, power and serviceability are arguments for its use that simply can't be overlooked.



Booklet E-10 for particulars.

CANTON FOUNDRY & MACHINE CO.
CANTON OHIO, U. S. A.



A Useful Handbook

If you are interested in efficient power transmission, you will find our new complete catalogue and treatise on chain driving, "Diamond Tooth Form for Roller Chain Sprockets," a most useful handbook.

This booklet contains valuable data regarding the application of chains and sprockets for power transmission and will prove of assistance to engineers and others in the solution of driving problems.

A new form of sprocket tooth has been developed by our engineers, which greatly increases the life and efficiency of both chains and sprockets. A complete description of this new tooth form is included in this booklet.

Chain drives are rapidly gaining in prominence—they afford a compact, powerful, positive method of power transmission. Engineers, designers, officials and others who are in touch with driving problems should have a copy of "Diamond Tooth Form for Roller Chain Sprockets" for reference.

BETTER TRANSMISSIONS

*An Aim—
Not A Claim*

*Mail coupon or write for
your copy today.*

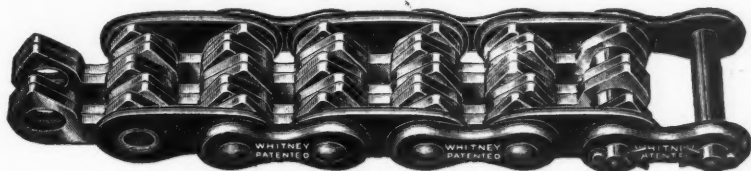
Diamond Chain & Mfg. Company

240 West Georgia Street
INDIANAPOLIS, IND.

COUPON	
DIAMOND CHAIN & MFG. CO. Indianapolis, Ind.	
Please send copy of new handbook, "Diamond Tooth Form for Roller Chain Sprockets."	
Name	
Street	
City	
Firm	
Position	
Machinery-8-17	

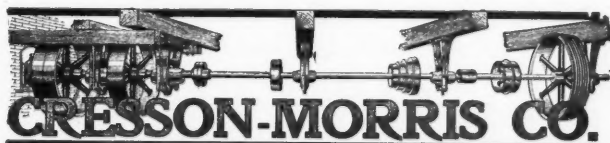
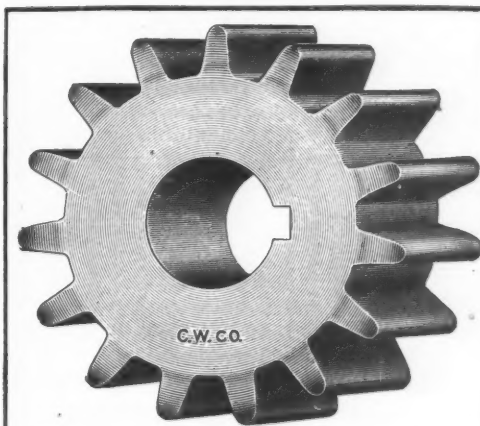
Cullman Sprockets

in stock and to order



*For Block, Roller and High Speed
Silent Chains. New Catalogue.*

CULLMAN WHEEL CO., 1339 Altgeld St., Chicago



Power Transmitting Machinery

Shafting
Pulleys
Hangers
Floor Stands

Every Power Transmission need is adequately met by the complete line and abundant experience of the

Pillow Blocks
Friction Clutches
Flexible Couplings
Gears for Heavy Service

CRESSON-MORRIS COMPANY

PHILADELPHIA

Engineers—Founders—Machinists

PENNA., U. S. A.

CHASE ELEVATING and TRANSFERRING TRUCK

Cuts Handling Costs

Save labor and floor space with Chase direct control, easy running roller bearing trucks.

Complete trucking and railway systems.

Write for
catalog
No. 16B.



THE CHASE FOUNDRY & MFG. CO., Columbus, Ohio

THE SHAW ELECTRIC CRANE COMPANY

WORKS MUSKEGON, MICHIGAN



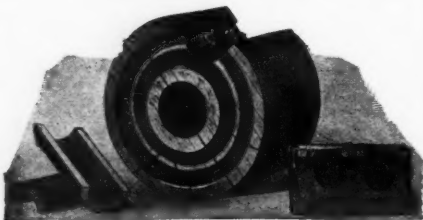
SALES OFFICES IN ALL PRINCIPAL CITIES

MANNING, MAXWELL AND MOORE, INC.

PRINCIPAL OFFICE - 119 WEST 40TH. ST., NEW YORK.

GILBERT PULLEYS

**COST
LITTLE and
SAVE MUCH**



Gilbert Wood Split Pulleys cost less than split iron or steel pulleys. Being much lighter, they require less expensive shafting and hangers, put less weight on the bearings, and so reduce power loss through friction.

It has been authoritatively proved that wooden pulleys require nearly 50 per cent less belt tension than iron—for equal power. Reduced tension prolongs belting life and further reduces journal friction and strain on the shafting.



Gilbert Wood Split Pulleys wear as long as iron, give as good or better service, and save money in every way.

Send for Catalog.

SAGINAW MFG. CO.

SAGINAW, W. S. MICHIGAN

Sales Agencies in all Principal Cities of the World.

New York Branch:
88 Warren Street

Chicago Branch:
105-109 So. Jefferson Street

Cable Address: Engrave
A. B. C. and Lieber's
Codes

GET OUR OFFICIAL BLUE BOOK



The BANTAM BALL BEARING CO.
BANTAM, CONN.

DETROIT OFFICE
905 Dime Bank Bldg.
DETROIT

F. M. COBBLEDICK & CO.
693 Mission Street
SAN FRANCISCO, CAL.

NEED THRUST BEARINGS QUICK?

Specify "ROCHESTER"

We make them—big bearings, good bearings. Balls, all sizes, any material. Speedy delivery on early orders. Write for circulars.



ROCHESTER BALL BEARING COMPANY, Inc., ROCHESTER, N. Y.

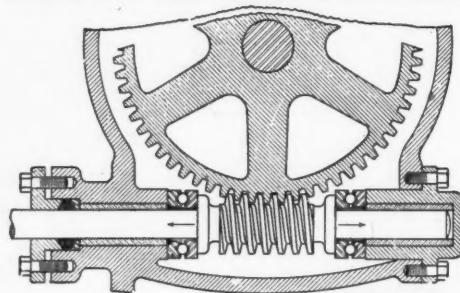
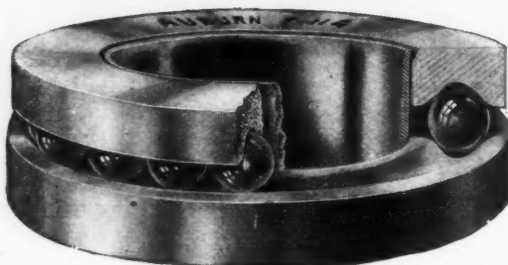
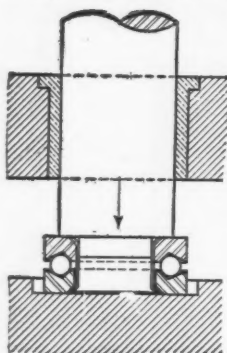
FREE BOOKLET SHOWING HOW TO SAVE HANDLING EXPENSE

How to enable 1 man to do the work of 4 or 5—
how to meet the labor shortage—by using the

BARRETT MULTI-TRUCK
BARRETT-CRAVENS CO.
750 Transportation Bld'g. Chicago, Ill.



Auburn Ball Thrusts Solve Problems Like These



State your needs or ask for bulletins.

Steel, Brass and Bronze Balls

AUBURN BALL BEARING COMPANY, 33 Elizabeth Street
ROCHESTER, N. Y.

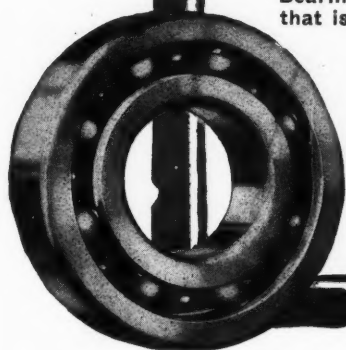




U.S. Ball Bearings~

Assurance of Quality Production

It is important first to remember in connection with U. S. Ball Bearings that only quality bearings are produced in the immense U. S. plant—one of the largest exclusive ball bearing plants in the world. This is positive assurance that every user of U. S. Ball Bearings receives only one quality bearing—the highest possible of production—for that is the only kind of U. S. Ball Bearing produced. In other words, in the U. S. Ball Bearings you find the most highly developed and most efficient ball bearings known to the manufacturing world—hence the most efficient anti-friction device obtainable.



U.S. BALL BEARING MFG. CO.

(Conrad Patent Licensee)

Palmer St. and Kolmar Ave.

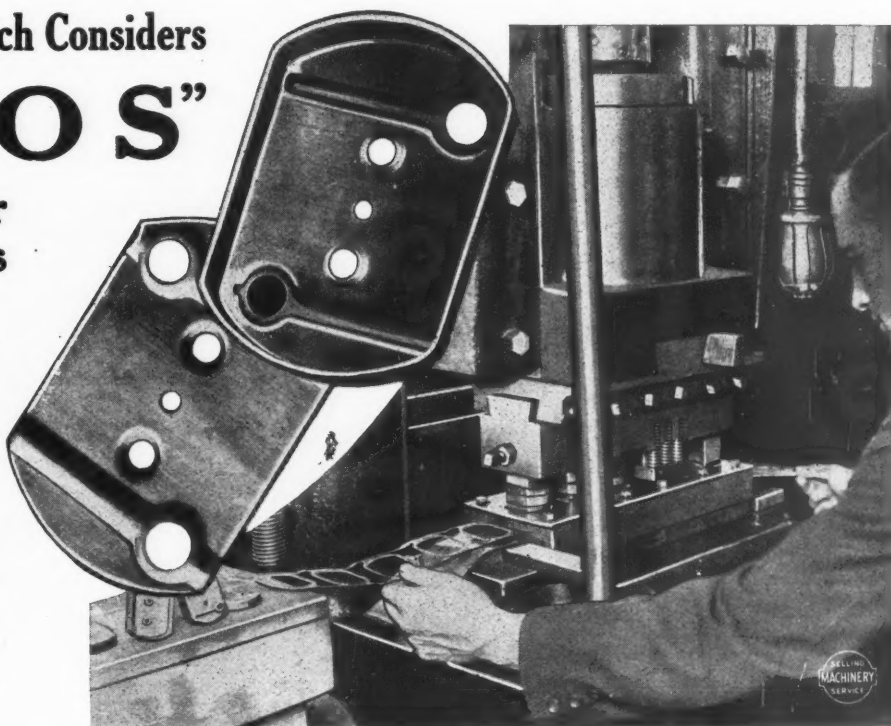
CHICAGO, ILLINOIS

Another Concern which Considers

"KETOS"

the Best Steel for
Punches and Dies

With years of punch and die making experience to judge from, the Bridgeport Metal Goods Co. finds that for intricate, hard working dies there is no steel quite like "Ketos." They showed the photographer this 8-step die in action, the remarkably fine cups it turns out—within 0.001" limit—and named a total production far in excess of that secured from any other steel, as proof. This concern has been a "Ketos" Steel user for the past eight years.



Give Ketos Steel a Trial.

HAWKRIDGE BROTHERS COMPANY

303 Congress Street

BOSTON, MASS., U. S. A.

FAFNIR

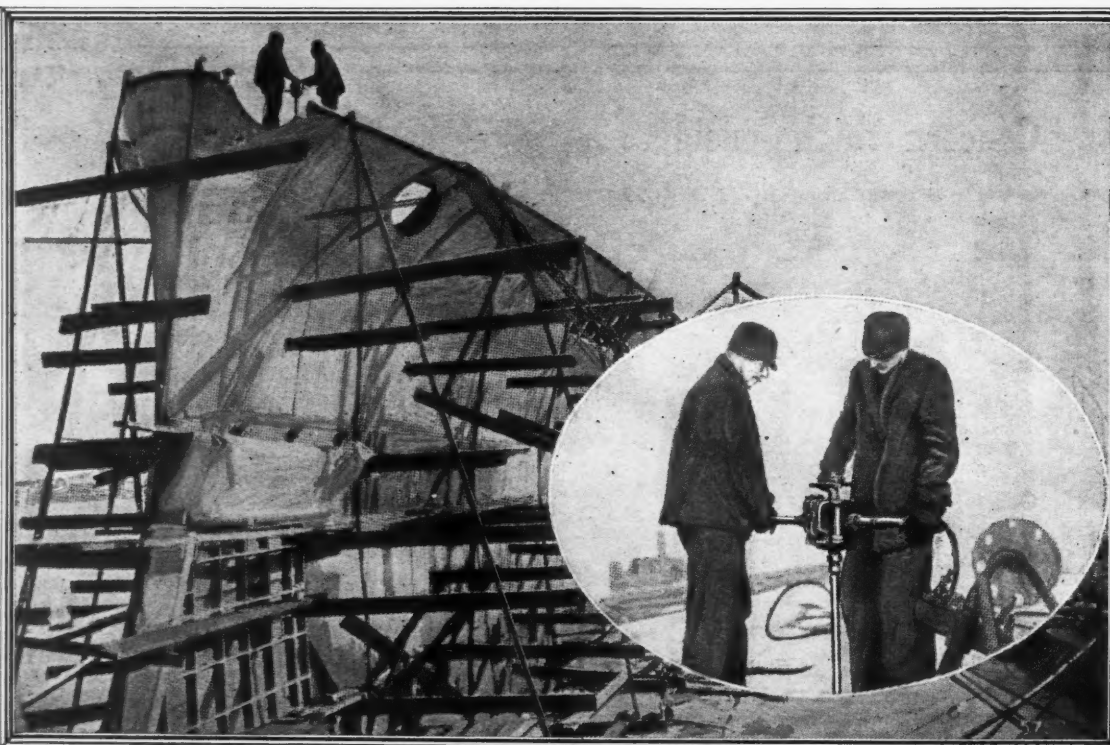
Reliability

The rough usage to which pneumatic tools are generally subjected makes staunchness and reliability essential qualities in every detail of construction.

Especially important are the bearings; since, if friction is to be reduced, power saved, and wear made negligible, it must be accomplished through the efficiency of the bearings.

*For bearing efficiency the Ingersoll-Rand Company
relies upon Fafnir Ball Bearings.*

May we have your inquiry?



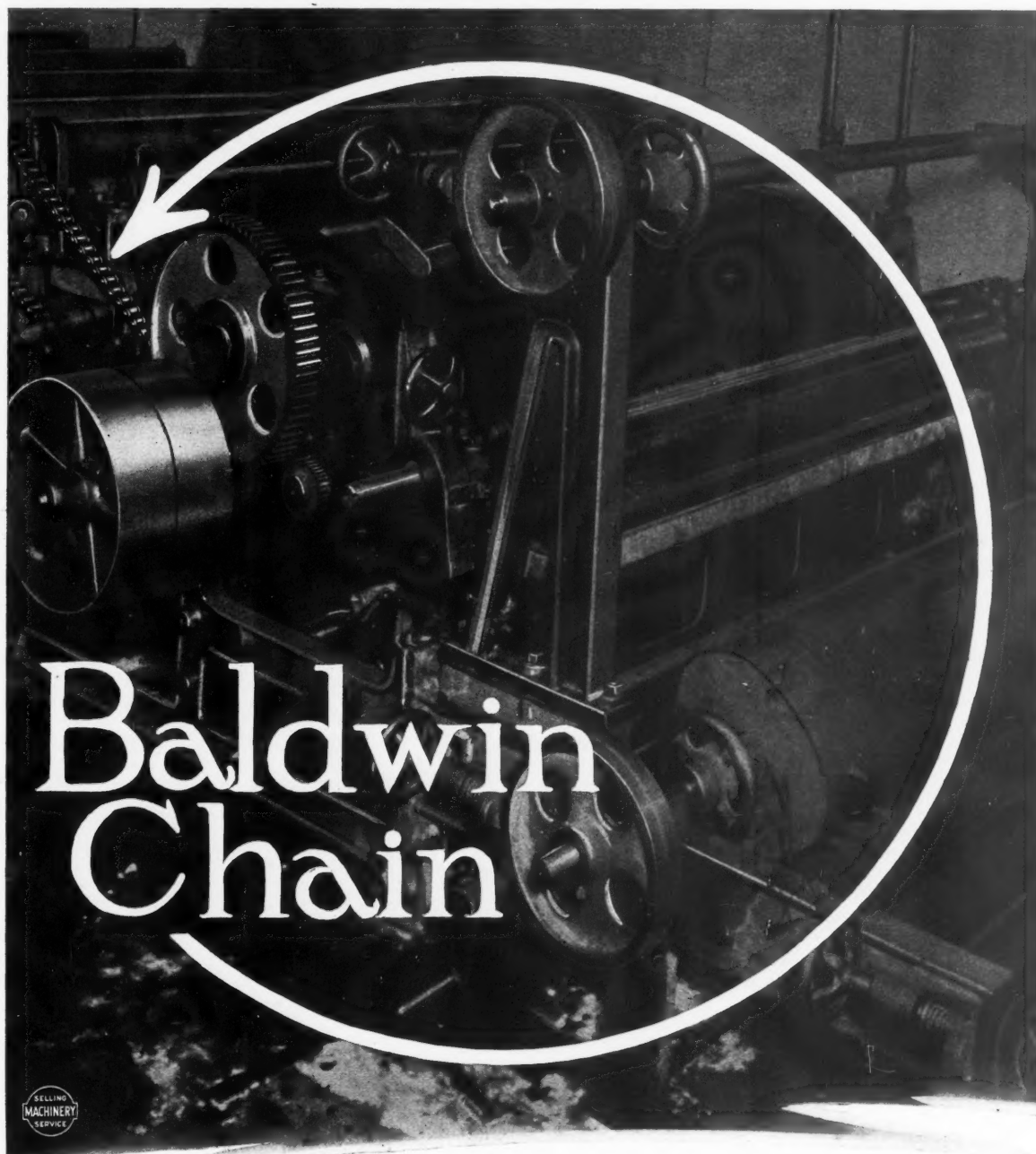
The Fafnir Bearing Company

Conrad Patent Licensee

Detroit Office:
752 David Whitney Bldg.

Main Office and Factory
New Britain, Conn.

Chicago Office:
39 So. Clinton St.



Another Special Machine

On Which Part of the Drive is Baldwin Chain

This is a paper corrugating machine, designed by the Potdevin Machine Company, Brooklyn, N. Y., and the drive to the upper rolls is a Baldwin Special Roller Chain, the center distance between sprockets being approximately two feet. The advantage of chain over gears or belts for many purposes has been demonstrated by the above concern to its complete satisfaction—and the chain selected is "Baldwin."

*Baldwin Chain is good chain. It has many uses and many advantages.
May we tell you more about it? Address Department "S".*

Baldwin Chain & Mfg. Co., Worcester, Mass., U.S.A.

AGENTS: C. D. Schmidt, 276 Canal St., New York City. W. D. Foreman, 1425 Michigan Ave., Chicago, Ill. N. A. Petry Co., Inc., 1309 Race St., Philadelphia, Pa. Walter H. Williams, 175 Massachusetts Ave., Boston, Mass. M. A. Bryte, 788 Mission St., San Francisco, Cal. Motor & Machinists Supply Co., Kansas City, Mo. M. & M. Co., Cleveland, Ohio. Neustadt Automobile & Supply Co., St. Louis, Mo. C. J. Smith Co., St. Paul, Minn.



"We Must Stop These Pulley Losses"

Pulley breakdowns—men and machines idle—are all too frequent in some plants. Belt slip and air resistance eat up power. Not enough attention is paid to the selection of pulleys. Perhaps wood and iron pulleys are still being used. Their first cost may be low but their last cost is far higher than

AMERICAN STEEL SPLIT PULLEYS

The flat A—braced arms of "American" Pulleys cut the air and save enormously on power. Belt slip is reduced to a minimum. "Americans" are guaranteed to perform double belt duty under all conditions not demanding a special pulley. They are capable of enduring higher speeds than any other standard metal pulley.

*FREE BOOK—"Pulley Efficiency" sent on request.
Full of money-saving pulley information.*

The American Pulley Co.

4208-60 Wissahickon Ave. PHILADELPHIA, PA.

New York, Cor. Grand and Greene Sts. Boston, 165 Pearl St.
Chicago, 124 S. Clinton St. Seattle, 536 First Ave., South.

PHILADELPHIA

Dynamo of the World War

Philadelphia is the dynamo of the world war. It is not local pride nor the appeal of high-sounding phrases that justifies this title, but the prime warranty of facts.

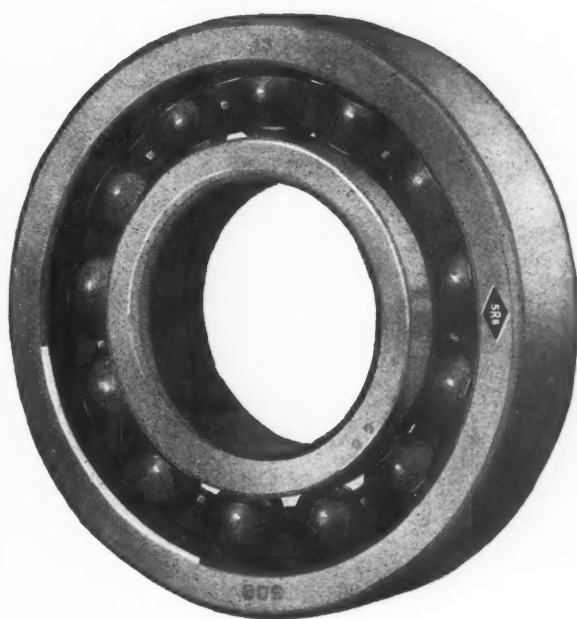
Russia and France are receiving our railway engines and equipment. Our munition plants gird civilization in the fray for liberty. Clothing and tools, farm implements, prepared foods, machinery, iron and steel construction—these are but a few of the array of products from Philadelphia's dynamo.

The Federal Government recognizes Philadelphia's exceptional position. At League Island Navy Yard alone new work involving an expenditure of \$18,000,000 is planned, and in the Philadelphia district half a hundred shipways hum with the fast-maturing hopes of a new merchant fleet and a mightier navy that must nullify the submarine.

In Europe's industrial organization, manufacturing centers have long been specialized. Locomotives hail from Creusot, arms from St. Etienne and Woolwich, textiles from Manchester, ships from Newcastle and Glasgow. Philadelphia is a Creusot, a St. Etienne, a Woolwich, a Manchester, a Newcastle and a Glasgow in one mighty whole.

The tide of her industrialism swells steadily.

—Public Ledger, June 10, 1917.



We are proud to be one of Philadelphia's leading institutions and to be doing our part to swell the "tide of her industrialism."

Standard Roller Bearing Company

PHILADELPHIA, PENNA., U. S. A.

Makers of SRB Annular Ball Bearings, Ball Thrust Bearings, Taper Roller Bearings, Steel Balls and Rudge-Whitworth Wheels



MAXIMUM SILENT ANNULAR BALL BEARINGS



Write
for
Details
and
Samples

TRY A GILMER ENDLESS BELT

For driving high-speed machinery—light grinding machines, polishing heads, drills, motors, etc.—the Gilmer Endless Woven Belt is without equal. It is dependable, insures smooth, even running, is pliable and does not slip.

Gilmer Belts are long lived—do not stretch, are not affected by oil, dust or moisture and are adapted for special conditions.

Made in single or double thickness, any specified length; regular widths from 1/2 to 6 inches—specials to specifications.

L. H. GILMER CO., Tacony, Philadelphia, Pa.

95% of All
Cars Carry Them



Not One Report of Breakage

A MARVELOUS record has been made by Hoover Balls in service. We make 25,000,000 new balls daily. During the four years of our 800% production increase, with billions of balls in service, not a single case of breakage has been reported.

The Hoover chrome steel, hard surface, tough center construction eliminates breakage by providing for steel contraction and expansion and allowing for fatigue in service. Our research laboratory will build the right ball for your service. Booklet free.

Hoover Steel Ball Company
Ann Arbor, Mich.

HOOVER Steel Balls

GWILLIAM SERVICE

BALL and ROLLER BEARINGS

ANNULAR—Single and Double Row
BALL THRUST—All Types
ROLLER THRUST—Collar Type
TAPER ROLLER—Standard
PRESSED STEEL—All Types
AUTOMOBILE, MOTOR BOAT and TRUCK BEARINGS

STEEL BALLS

Sole Agents for the United States of

THE BOWDEN PATENT WIRE MECHANISM
for the transmission of reciprocating motion
through a Flexible and Tortuous Route

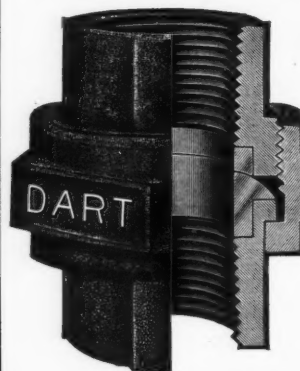
THE GWILLIAM COMPANY

Engineers and Specialists

NEW YORK, 253 W. 58th St.
Phone: Columbus 8355

PHILADELPHIA, 1314 Arch St.
Phone: Walnut 3497

Like the Statue of Liberty



The life of a pipe union is limited by the capacity of the seats to resist rust and corrosion. Take a look at Bartholdi's statue, which has been exposed to the elements for 30 years, and you will get an idea of the lasting quality of the "bronze to bronze" seats of Dart Unions.

A sample sent on request, also complete list of Dart Elbs, Tees, Flanges, etc.

E. M. Dart Mfg. Co.

Providence Rhode Island
The Fairbanks Co., Sales Agents,
Canadian Factory: Dart Union Co.,
Ltd., Toronto.

F. BROWN'S PATENT FRICTION CLUTCH COUPLINGS AND PULLEYS



FRICTION CLUTCH PULLEY

FOR HIGH SPEED FOUNDERS FOR HEAVY DUTY



POWER TRANSMISSION
MACHINERY

GEARS

FOR MOTOR, MACHINE, MILL OR POWER PLANT
ROPE DRIVES A SPECIALTY

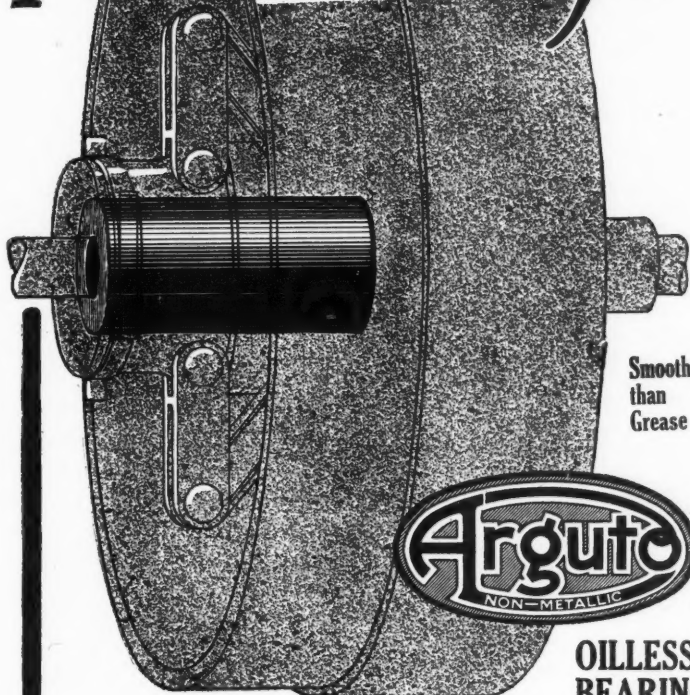


FRICTION CLUTCH PULLEY

We lay out, make the drawings, furnish the material, and erect it. Special machinery built to drawings and specifications.

WORKS:—ELIZABETHPORT, N. J.

An Increase From 6 days to 5½ Years



Smoother
than
Grease

**OILLESS
BEARINGS**

That is but a typical any day record for Arguto Oilless Bearings—but just to get the story out in the way it came to us, note these two letters.

.....
We also wish to advise that we received the twelve bearings covered by our order No. 914, and beg to advise that your bearings are giving the best of satisfaction; in fact we are using them on Erie clutch pulleys where brass would not stay over six days.

Yours truly,
Pioneer Pole and Shaft Company.

The Arguto Oilless Bearing Co.,
149 Berkley St.,
Philadelphia, Pa.

Dear Sirs:

We send you herewith an Arguto Bearing which we ran continuously for about five and one-half years as the bushing of a clutch pulley. This bearing has lasted in a remarkable manner, being apparently as good as when first received.

Yours very truly,
Collins and Aikman Co.,
(Signed) M. G. Curtis, Mgr.

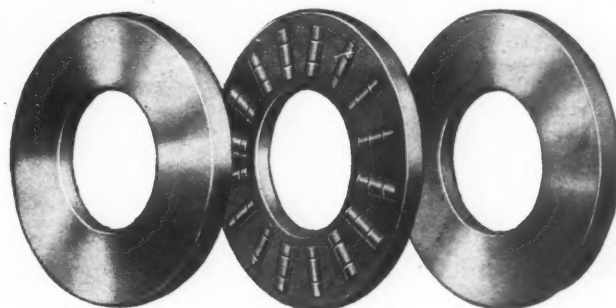
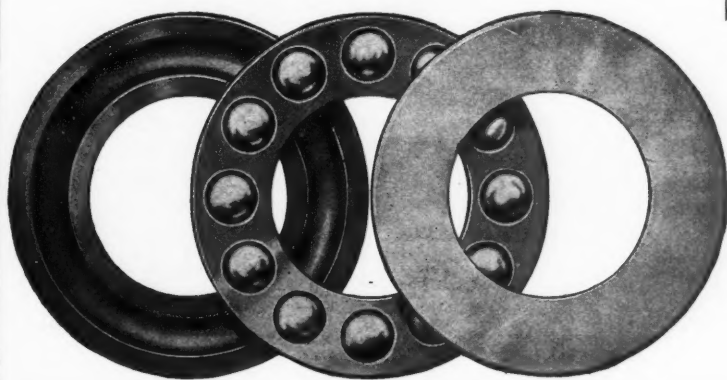
Arguto Oilless Bearings *do* outwear the best bronze; they *do* reduce overhead charges; they *do* eliminate both life and fire hazards in the lubrication of transmission machinery; they actually *do* increase production efficiency. Ask us how, there's no obligation.

Arguto Oilless Bearing Company
145 Berkley Street

Wayne Junction Philadelphia

We Are Doing Our Bit To Keep Machinery Running Smoothly

Somewhere along the line of progress there's a machine not giving the best of service, due to lack of anti-friction bearings. It may be in your plant. If it is, a complete line of anti-friction bearings awaits your consideration.



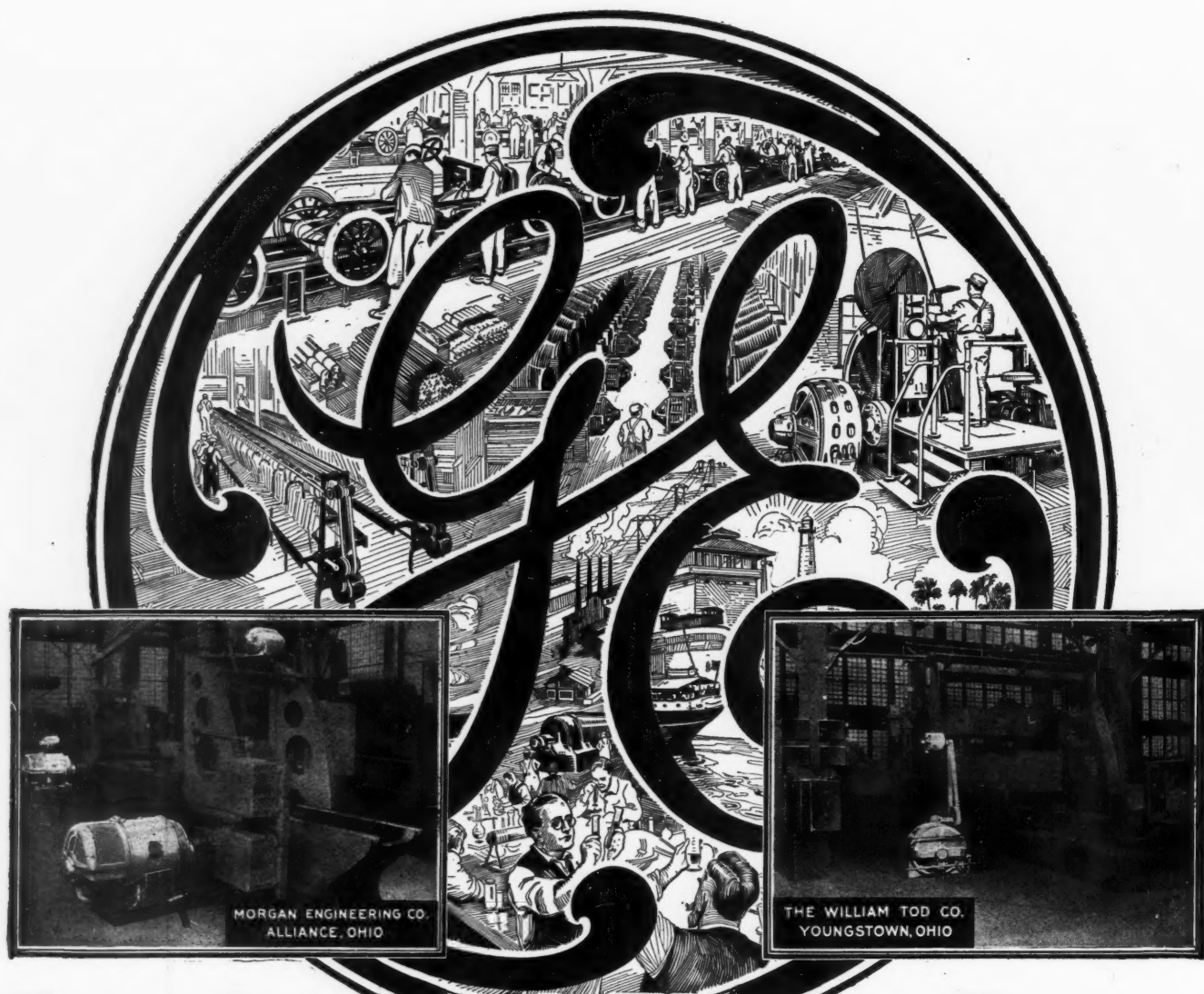
We make a bearing of guaranteed quality that will overcome the trouble; send blue prints and specifications and we will be glad to estimate.

Have you our catalog?

**THE BALL & ROLLER
BEARING COMPANY**

DANBURY

CONNECTICUT



Speed up with Electric Power

G-E Motors and Control increase production and reduce maintenance.

HERE are some of the ways in which modern industry has been speeded up by putting electric power to work in the right place.

Metal mines have boosted output to meet world-wide demands. Great central power plants in place of small local plants in coal mining areas now supply cheaper electric power per ton output for each mine. All tonnage records have been smashed in the steel industry. Greater automobile output has lowered prices and given better road transportation. More and better cloth has been produced at lower power costs.

The engineering problems solved in putting electric power to work in these and other industries were many and intricate. Production of electrical equipment suited to this work and in quantities required is an important part of this company's service to American industries.

Any problem involving the use of power can be simplified by the application of electricity. The General Electric Company is well equipped to lend valuable assistance in working out such problems and is glad to co-operate with manufacturers and engineers in every possible way.

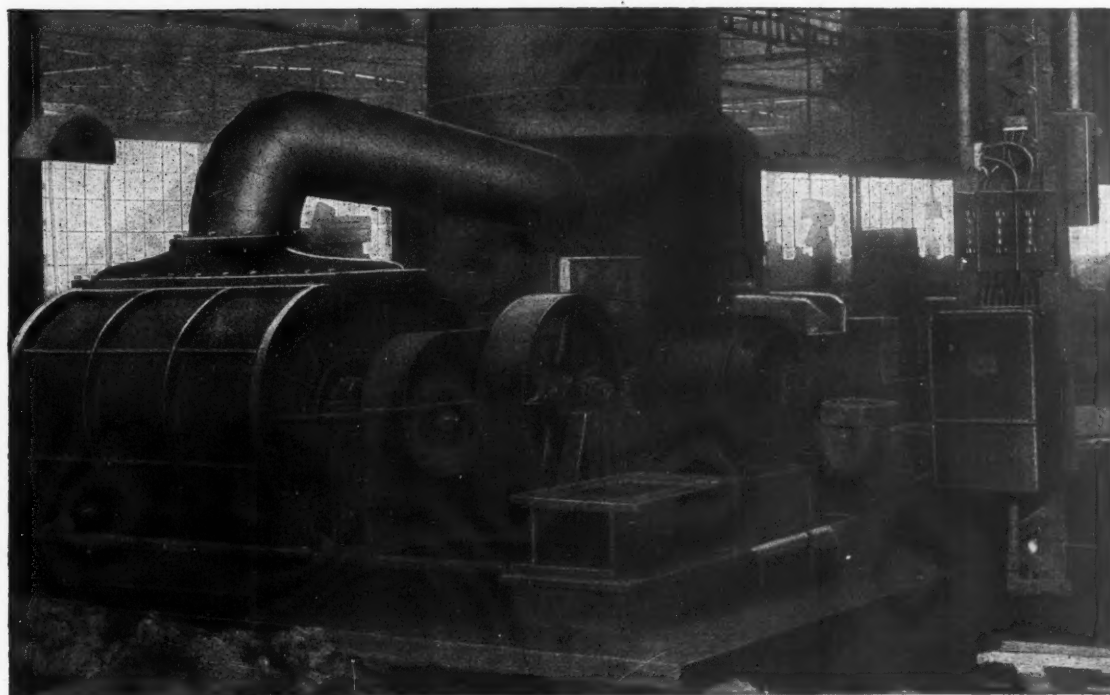
G-E Motor Drive

GENERAL ELECTRIC COMPANY

General Office, Schenectady N.Y.



Sales Offices in all large cities



Wagner Polyphase Motor Driving Cupola Blower

A Liability or An Asset?

How can you honestly class your motors? This is more serious than appears at first glance.

Motors are a liability when they are unreliable, prone to break down, responsible for interrupted production and unproductive labor and frequently in need of repairs.

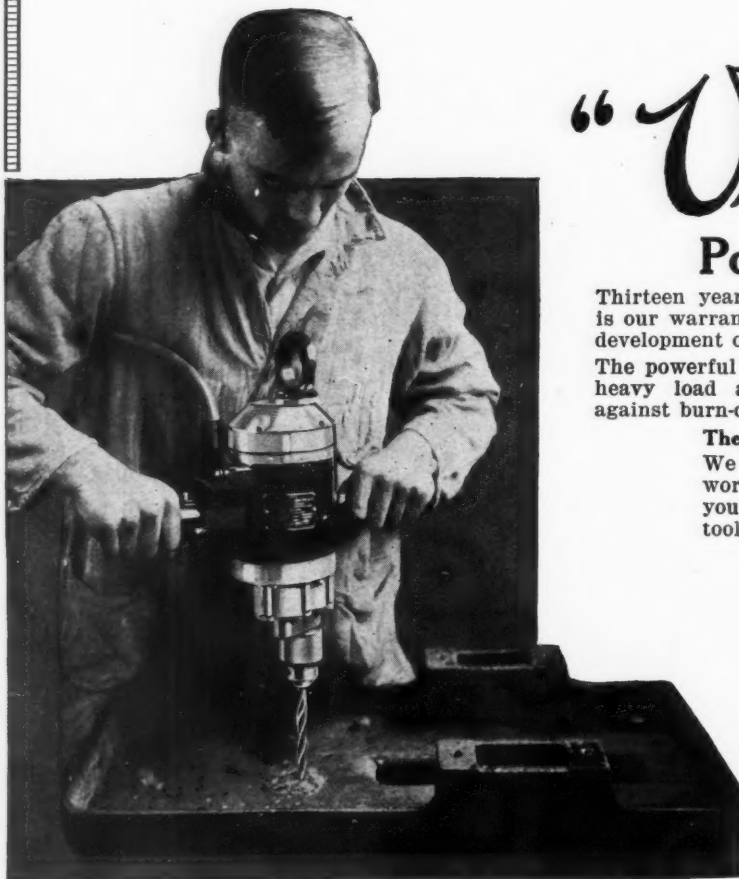
Wagner, Quality

Motors are an asset when they are trustworthy, free from repairs, built to withstand overloads and for day in and day out service. In a word, when they are quality-built-in dependable motors.

Are you specifying any motors and getting a liability or do you say Wagner, Quality and get motors you can add to your assets? Send for Bulletins 11024 and 11124.

Wagner Electric
Manufacturing Company, St. Louis, Mo.

THEY STAY ON THE JOB—THEY'RE DEPENDABLE



“Van Dorn”

Portable Electric Drills

Thirteen years of specialization on portable electric tools only is our warrant for the statement that our drills are the highest development of this type of machine tools.

The powerful Van Dorn-made motor will carry an exceptionally heavy load and the patented semi-automatic switch guards against burn-outs and fused switch contacts.

They Stay On the Job Until the Job is Done

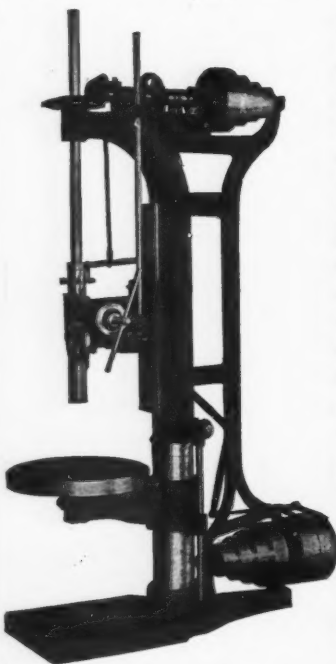
We make a tool for almost every kind of work, one for yours. Tell us the nature of your work and we'll quote on a labor-saving tool for you. Send your data to Dept. M.

The Van Dorn Electric Tool Co.
Cleveland, O.

SALES OFFICES:

New York, N. Y.	30 Church Street
Boston, Mass.	170 Purchase Street
Chicago, Ill.	601 Monadnock Building
Pittsburgh, Pa.	701 Empire Building
Cincinnati, O.	1102 Second National Bank Building
Atlanta, Ga.	1018 Healy Building
St. Paul, Minn.	1005 Germania Life Building
Denver, Colo.	1633 Tremont Street
San Francisco, Cal.	66 Eighth Street
Los Angeles	1019 Wright & Collander Building
Milwaukee, Wis.	529-36 Wells Building
El Paso, Texas	324 Mills Building
Salt Lake City, Utah	311 Walker Bank Building

SIBLEY Sliding Head Drill



28" swing. Height spindle up, 123". Maximum distance spindle to base, 55". Maximum distance spindle to table, 40". Traverse of table, 16". Traverse of head, 25". Feed of spindle, 10 1/2". Eight spindle speeds, 16 to 294 R. P. M. Four feeds to each speed per revolution of spindle—.008", .013", .016", .024". Horsepower required, 2. Weight net, 1800 lbs. Weight boxed, 2200 lbs. Code word CHURN.

Also a complete line, 16" to 30" swing.

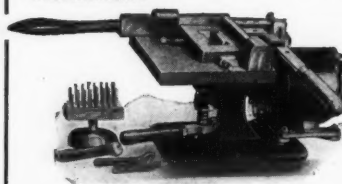
Write for Catalog

SIBLEY MACHINE COMPANY
8 TUTT STREET, SOUTH BEND, IND., U.S.A.

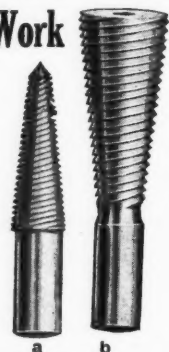
Tapered Cutters for Relay Team Work

Anderson's Superhelical Tapered Cutters, for use on Anderson's Die Forming Machine, are adapted to produce dies of intricate form and varied degrees of clearance.

Cutter a—for finishing openings—followed by cutter b—for outside finishing—produces patterns of uniform inside and outside draft of the proper angle. This team work speeds up production, which is further accelerated by our Universal Pivoted Feed Mechanism.

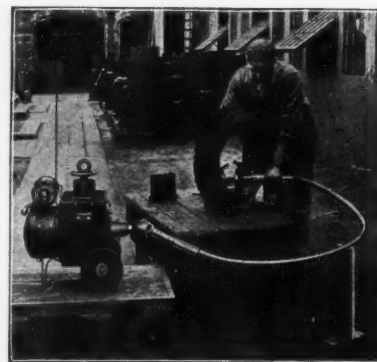


Write for
Details



The Anderson Die Machine Company
Bridgeport Connecticut

STOW GRINDERS



Portable
All sizes

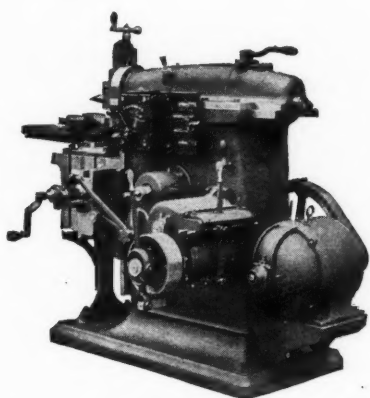
Rope and
Motor driven

No welding job is finished unless properly ground. Write today for details with illustrations.

STOW MFG. COMPANY

Binghamton, N. Y.

Oldest Portable Tool Manufacturers in America



**T
R
I
U
M
P
H**

Triumph Adjustable Speed Commutation Pole Motors

Are Ideal for Machine Tool Drive
Are Non-Sparking at Any Speed
Have Wide Speed Range
Develop High Starting Torque
Have Liberal Overload Capacity

Ask for descriptive bulletin

Triumph Electric Co., Cincinnati, O.
Branches in All Leading Cities

"Willey" Electric Portable Drills ARE HANDY TO HAVE IN THE SHOP

In less time than it takes to load your work on a truck and take it to the drill press, the "Willey" has the first hole drilled and is well on its way through the second.
For light drilling, up to 3/4 inch, the "Willey" is the tool for quick, accurate, economical service.

Send for New Catalog No. 26

JAMES CLARK, Jr., ELECTRIC COMPANY, Incorporated
522 W. Main Street, Louisville, Kentucky

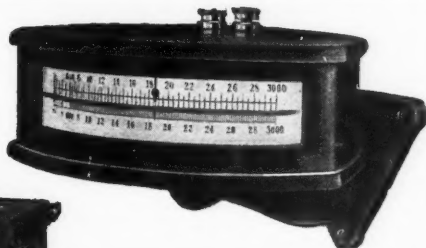
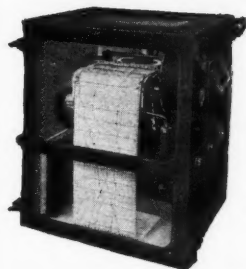


PATENTED

"WILLEY"
TOOLS
ALL-WAYS
CORRECT
MECHANICALLY
ELECTRICALLY

BRANCHES: 31 N. Jefferson St., Chicago, Ill.; 1309 First National Bank Bldg., Pittsburgh, Pa.; 154 Nassau St., New York, N. Y.

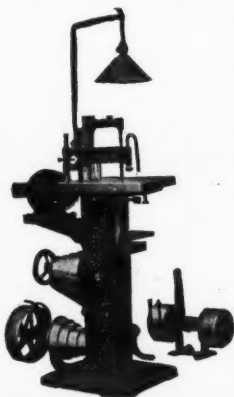
Indicating and Recording



PYROMETERS

Wilson-Macaulen Co., Inc.
783 E. 142 Street, New York

The Rearwin Die Filing Machine



has 480 pounds of efficiency as follows: Table 17 x 18", 39" from floor. Supported on a yoke and tilts 7 degrees four ways. Has two adjustable arms. Uses files and hacksaws 3 to 12" in length. Adjustable stroke 1/2 to 7". Is driven with a 2" belt over a 12" friction pulley. Speed is varied with two cone pulleys, 4 steps, 4 to 8".

Circulars are yours
for the asking

W. D. REARWIN
341 Mill Ave., Grand Rapids, Mich.

Thor

Universal Electric Drills

Licensed Under Burke Universal Motor Patent

The only portable electric tools made that are equipped throughout with ball and roller bearings. Made with aluminum cylinder, insuring extreme lightness, and a powerful specially constructed motor resulting in increased capacity. Can be furnished with Universal, Alternating or Direct current motor 110 to 250 volts.

- 000 Drilling Capacity 1/4"
- 00 Drilling Capacity 5/16"
- 0 Drilling Capacity 3/8"
- 01 Drilling Capacity 1/2"
- 1 Drilling Capacity 9/16"

No. 6 Electric Grinder, wheel 4" x 3/4".

SHIPPED ON TRIAL

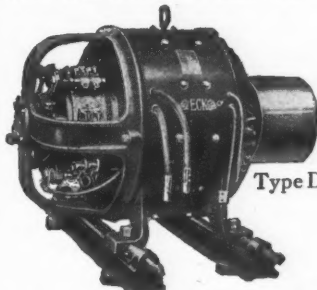
INDEPENDENT PNEUMATIC TOOL CO.

CHICAGO NEW YORK PITTSBURGH DETROIT
SAN FRANCISCO BIRMINGHAM MONTREAL

"One Thor-More Thors"

ECK "HIGH-GRADE" MOTORS WITH COMMUTATING POLES AND SELF-ALIGNING BALL BEARINGS

Sizes 40 H. P.
and Smaller.



Type D

Unequaled
Electrical and
Mechanical
Performance for
Machine Tool
Applications.

Send for Bulletin No. 1000-B
for complete description.

ECK DYNAMO & MOTOR CO., Belleville, N.J.

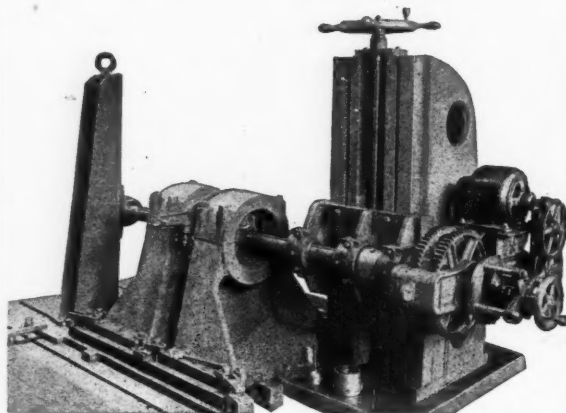
The Pedrick Column Boring Machine Is Needed In Your Shops This Minute

Orders are coming in for this machine in groups—not singly. And as soon as its merits are generally appreciated larger numbers will be wanted.

Even a casual inspection will impress these facts:

**Simplicity
Range of Work
Power
Moderate Price**

The unusual boring capabilities of the machine afford new methods of doing work. The boring bar may be passed through



Boring and Facing a Pair of Pedestals

PEDRICK TOOL & MACHINE COMPANY

3639 North Lawrence Street
PHILADELPHIA, PA.

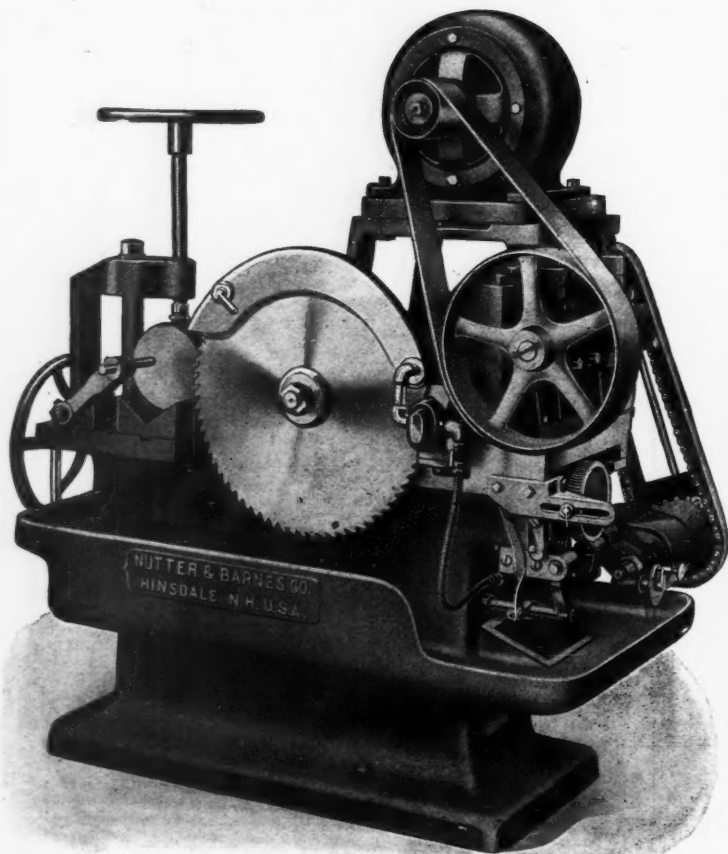
Manufacturers of Portable Cylinder Boring Bars, Crank Pin Turners, Pipe Benders, Portable Milling Machines, etc.

the work with a cutter head traveling along the bar to do the boring, or the bar feeds in the regular manner with the cutter keyed fast or operating auxiliary boring bars. The machine may be set-up in a permanent position or it may be taken to the work.

If you need more boring machines these advantages must appeal to you. We have the machine; it has been tried out and is not an experiment.

Send for your circular now.

Nutter and Barnes Cutting-Off Machines



Massiveness without clumsiness, convenience without superfluous parts, speed, accuracy and range—all combine to put these machines in a distinct class. Size of saw considered, their capacity is greater than any other cutting-off machine; their economy in blades and saw kerf is remarkably high, while their ability to stand hard, driving service is a factor that insures highest returns on the investment.

Complete Details in Catalog.

NUTTER & BARNES CO.

The Metal Cutting-Off Machinery Specialists
HINSDALE - NEW HAMPSHIRE
13 South Clinton Street, Chicago

FOREIGN AGENTS: England, Alfred Herbert, Ltd., Coventry; Scandinavia, Wihl. Sonesson & Co., Ltd., Malmö, Sweden; Copenhagen, Denmark, Russia, C. Schinz, Petrograd. **Allied Machinery Co. of America**, 19 Rue de Rocroy, Paris, France; Via XX Settembre 12, Turin, Italy; 16 Seidengasse, Zurich, Switzerland; Ekaterininskaya 6, Petrograd, Russia; Malaya Lubianka 16, Moscow, Russia. Spain, Sociedad General de Representaciones, Madrid. Australia, A. Asher Smith, Sydney. South America, A. G. Burbanks, Buenos Aires, A. R. **DOMESTIC AGENTS:** Swind Mch. Co., Philadelphia, Pa. Patterson Tool & Supply Co., Dayton, Ohio.



Grant Riveters

Help Make
Good Shears

This little battery of eight bench type Grant Riveters rivets 240 gross scissors per day for the Acme Shear Company, Bridgeport, Conn., *without breaking a single casting.* The Acme Company probably makes more scissors, shears, etc., than any one concern in the world. Considering the finish and durability of their product, their choice of Grant Riveters is significant.

Grant Machines rivet perfectly, noiselessly, economically and at record breaking speed

GIVE GRANT RIVETING A TRIAL

GRANT MANUFACTURING & MACHINE COMPANY

N. W. STATION, BRIDGEPORT, CONN.

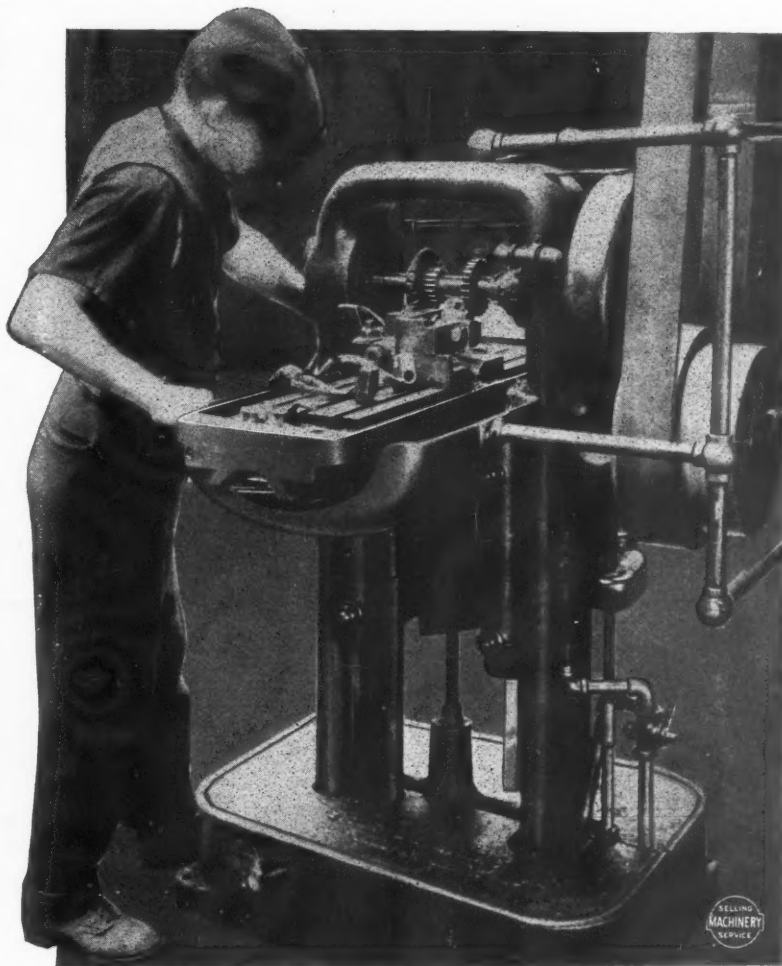
BRIGGS MILLERS in the "Hudson" Plant

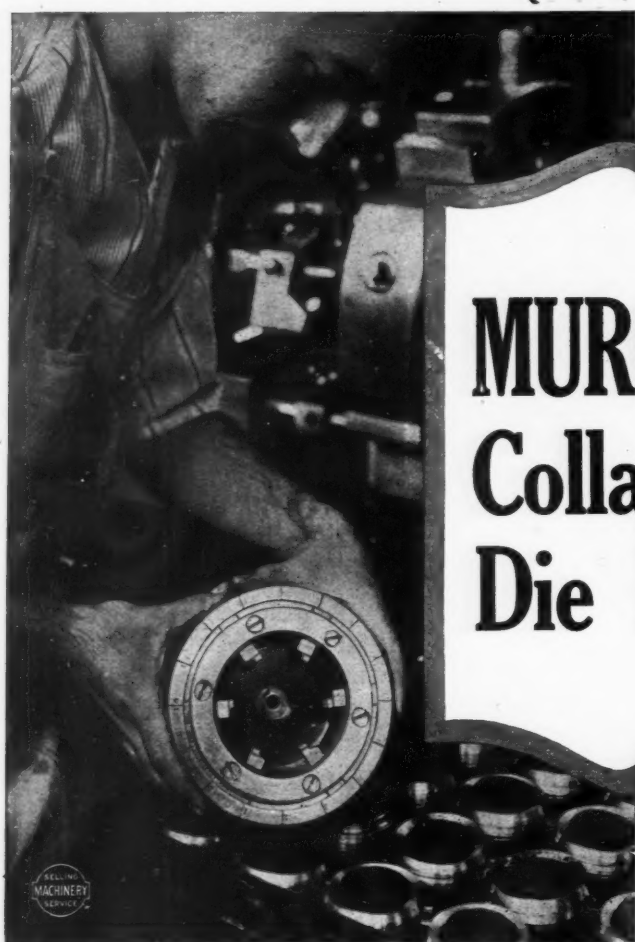
Many of the foremost manufacturing concerns of the country have learned that differentiating between milling and "Briggs" Milling is a profitable departure. They've found that over a wide range of application "Briggs" means better work and more of it, greater economy and longer service. In the Hudson Motor Car Co.'s plant, Detroit, Mich., "Briggs" Millers are making a particularly fine showing, being used exclusively on many operations requiring the closest limitations. It'll pay you to investigate "Briggs" possibilities on your work.

Write for particulars.

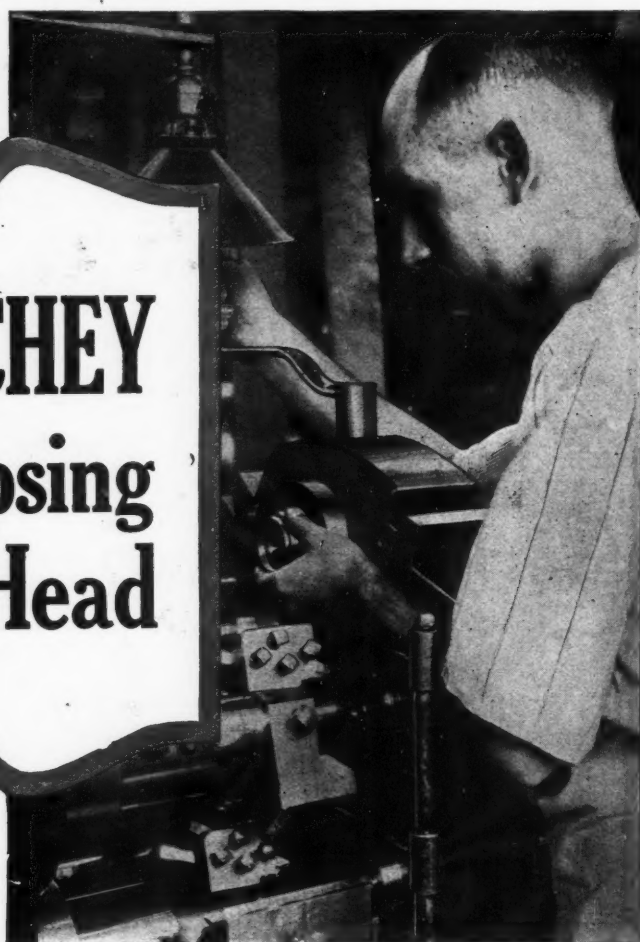
GOOLEY & EDLUND, Inc.
CORTLAND N. Y., U. S. A.

DOMESTIC AGENTS: Chandler & Farquhar Co., Boston, Mass.; Vandyck Churchill Co., New York and New Haven; Swind Machinery Co., Philadelphia, Pa.; Syracuse Supply Co., Syracuse, N. Y.; O. R. Adams, Rochester, N. Y.; Brown & Zortman Machinery Co., Pittsburgh, Pa.; English & Miller Machinery Co., Detroit, Mich.; Federal Machinery Sales Co., Chicago, Ill.; Vonnegut Machinery Co., Indianapolis, Ind. FOREIGN AGENTS: Allied Machinery Co. of America, Paris, Turin, Zurich, Petrograd, Barcelona; Burton, Griffiths & Co., Ltd., London, Manchester and Glasgow; Andrews & George, Tokyo.





MURCHEY Collapsing Die Head



For economical
reasons give
Murchey Tools
a trial.

750 in 10 Hours

These pictures were secured recently from a western manufacturer who has a habit of short-cutting his way to results with the best equipment that can be bought.

They show Murchey Die Heads—12 of 'em—operated on 12 New Britain Automatics, cutting the threads in nose pieces for 3" shells. Thread is $2\frac{1}{2}$ " diameter, 20 pitch Wentworth, 5 threads to the piece.

The Murchey "Automatic" combination turns out accurately threaded nose pieces at the rate of 750 in 10 hours, each machine, or 9000 in 10 hours from the twelve.

Murchey Tools are high speed thread cutters. Their work is clean cut, accurate, finely finished and economically done. Practically every threading operation can be handled with taps and dies picked from the Murchey stock. If special tools are required we can furnish them in short order.

MURCHEY MACHINE & TOOL CO.
34 PORTER STREET
DETROIT, MICHIGAN

Great Britain, Ireland and British Colonies, Coats Machine Tool Company, Limited—LONDON — NEWCASTLE-ON-TYNE — GLASGOW. France: Fenwick Freres & Company, 8 Rue de Rocroy, PARIS.

FOR AIRPLANES

—Immediate Deliveries—

If you are building planes for the war or any purpose, we can serve you.

For years we have made essential parts for airplane builders.

Write us for information as to our engineering assistance and our facilities.

*Steel Tubing and Special Formed Tubes,
Rims, Springs, Forgings, Bearings,
Special Rod Assemblies, etc.*

The present urgency of requirements among those who are manufacturing or who contemplate the manufacture of airplanes finds us fortunately placed to be of valuable assistance.

THE STANDARD PARTS CO.

CLEVELAND, OHIO, U. S. A.

Branch Sales Offices:

NEW YORK

CHICAGO

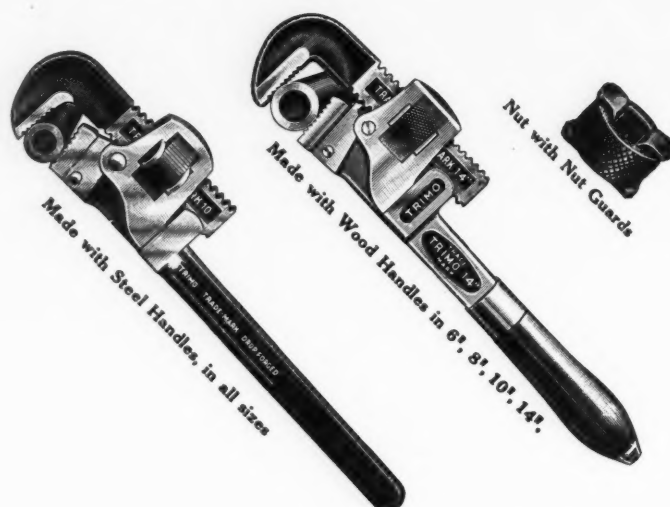
DETROIT

When Ordering **STILLSON WRENCHES**

Demand **TRIMO** with the
Steel Frames and Nut Guards

Of all Stillson
Wrenches

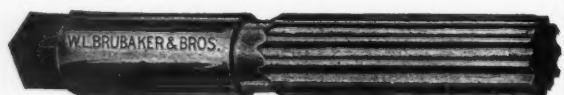
TRIMO
is the Best



SEND FOR CATALOG No. 38.

Made by **TRIMONT MFG. COMPANY**
55-71 Amory Street
Roxbury, (Boston), Mass.

BRUBAKER TOOLS



No detail of equipment bears more directly upon production than small tools. Machines may be first class, workmen thoroughly competent, but output will never reach the mark it should unless the tools complete the triangle. If you are still retarding output by the use of inferior tools it's time Brubaker's got a chance. Brubaker Tools are quality tools through and through. They embody the best in design, material and workmanship. They will reduce screw cutting costs, insure good work and are dependable under all conditions.

Send your next order to Brubaker.

W. L. BRUBAKER & BROTHERS
MILLERSBURG

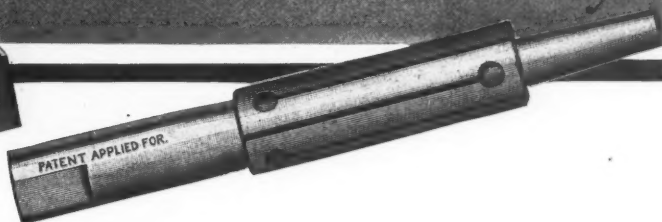
EASTERN REPRESENTATIVES: F. E. Harrison, 50 Church Street, New York. W. Searls Rose, 50 Church Street, New York.

PA., U. S. A.

CHAMPION

TOOL HOLDERS — MANDRELS

for Heavy Cuts *Hold Securely*



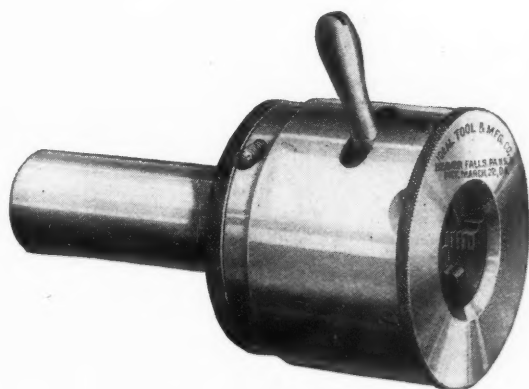
Not only for heavy cuts, but also for reducing tool costs. Champion Tool Holders are made with the big head construction which gives solid support to the cutter proper, permits taking the heaviest cuts on modern machines, saves 75 per cent of high-speed steels and lowers grinding costs. Adapted for planer, shaper or lathe and made in all types.

Champion Expanding Mandrels hold securely because they expand uniformly and grip positively *without distorting* the work. One of the greatest economies you can make is to junk your whole stock of solid mandrels for Champion Expanding Mandrels.

Let us show you.

THE WESTERN TOOL & MANUFACTURING CO., Springfield, Ohio, U.S.A.

FOREIGN AGENTS: Alfred Herbert, Ltd., Great Britain, Italy, France, etc. V. Lowener, Copenhagen, Stockholm. Spliethoff, Beeuwkes & Co., Rotterdam. W. R. Grace & Co., Chili, Peru and Bolivia.



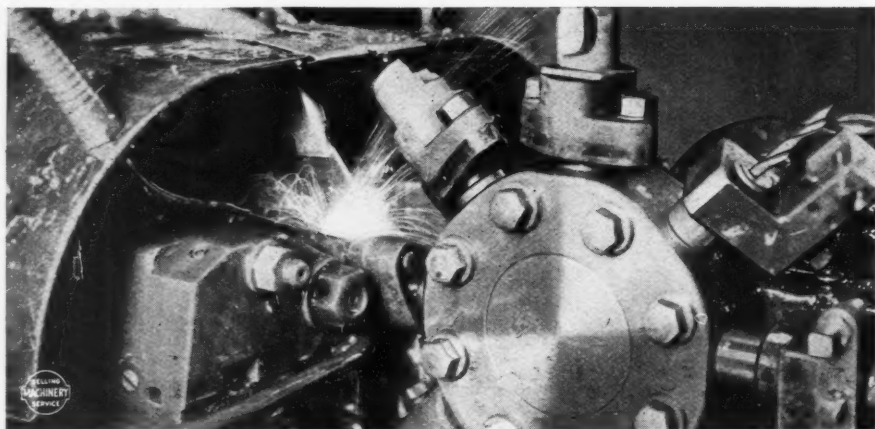
IDEAL ALL WAYS

Manning, Maxwell & Moore, Inc.,
119 W. 40th St., New York City.
Swind Machinery Co.,
Widener Bldg., Philadelphia, Pa.
H. E. Barton Tool Co.,
106 South Jefferson St., Chicago, Ill.

IDEAL DIES

Are big time savers. They make it possible for you to obtain clean, straight, absolutely accurate threads at a fast rate of production. They are simple in construction; have fewer parts than any other similar tool; can be quickly and easily taken apart; cut either right or left hand threads. Prompt deliveries on both dies and chasers.

**THE IDEAL TOOL
& MFG. COMPANY**
BEAVER FALLS, PENNA.



Climax Mineral Lard Oil

Best for Many Purposes

CLIMAX Mineral Lard Oil is a scientific combination of the best fatty oils and has been used successfully for 40 years for all manner of cutting operations. It can be used as a base for many cutting oils or can be used straight, and if desired may be readily converted into a water solution by the addition of a small quantity of sal soda and water. It prolongs the life of tools and increases output; does not gum, separate or turn rancid; does not cause infection in open wounds. Truly, for many purposes Climax is without an equal.

Send for samples and give Climax a thorough tryout on your machine.

FISKE BROS. REFINING COMPANY
 24 STATE STREET Manufacturers of the well-known Magic Soluble Oil and Magic Cutting Compound **NEW YORK CITY**

EX-EL-ARD

THREADING OIL

Can save you money. First, because it means longer life for your dies by really keeping them cool. Second, because it goes twice as far as the best of winter-strained lard oil, and third, because a threading job treated the Ex-El-Ard way need never be done over—smooth, firm threads the first time.

Here's the big reason for Ex-El-Ard's superiority, and it's worth remembering. There is only 2% of free fatty acid (the deadly enemy of all metals) in Ex-El-Ard, while the best grade of lard oil has seldom less than 6%.

Your jobber or the manufacturers will be mighty glad to send you a ten-gallon can of Ex-El-Ard on thirty days' free trial, and will be equally glad to have you return it if it doesn't live up to their claims.

G. A. HOSMER CO., Buffalo, N. Y.

COMPLETE LINE OF
GREASE CUPS
OILERS AND OIL CUPS

Send for Catalogues today.

THE WINKLEY COMPANY
 DETROIT MICHIGAN

SPECIALIZED ON OIL CUPS

GITS OIL CUPS

Give perfect satisfaction where others fail. State style and size in which you are interested, and we will send free samples and catalog.

GITS BROS. MFG. CO.
 553-557 W. MONROE ST., CHICAGO

HIGHEST QUALITY LOWEST PRICES



If Germany Saves the Oil from Waste, Why Shouldn't We?

"A recent report says that Germany has discovered a new process for extracting oil from cleaning waste. It is estimated that 18 million Kilograms of oil have thus been recovered."—From the *New York Evening Mail*.



CLEANS WASTE AND CLOTHS

from 50 to 150 times at a cost of $\frac{1}{2}$ cent per pound for waste and $\frac{1}{8}$ of a cent per cloth.

A thorough soaking in OAKITE Solution, then a simple steam wash, and waste is absolutely clean and a better absorbent than when new.

OAKITE cleans on a new principle. It emulsifies oils and greases—breaks them up into finely-divided particles, thus destroying their adhesive nature. This is a purely physical action. That is why the oil may be reclaimed from waste and cloths and used over and over again. It is not affected chemically or physically—does not lose any of its original properties.

OAKITE absolutely will not injure fibres—neither will it injure the hands. It contains no acid, lye, sal soda, caustic, soap, washing powder, grease, fat or oil.

Our Service Department will show you how to save oil which is ordinarily thrown away. We have a staff composed of men who know cleaning from every angle. Their services are freely at your disposal. Send for one of them and let him demonstrate OAKITE in your plant for you.

Thirty-day Trial Offer

Write for details of our offer to send a barrel of OAKITE on thirty days' trial subject to the terms of our Positive Guarantee

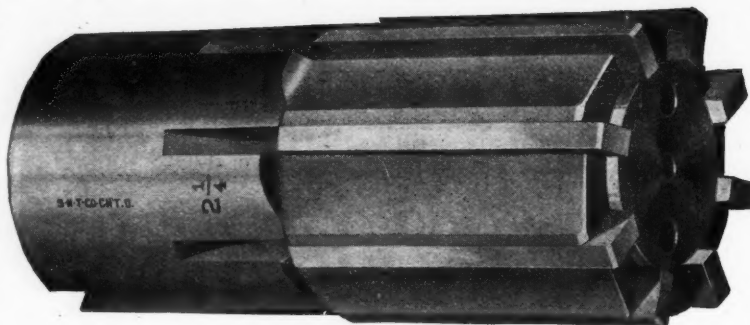
OAKLEY CHEMICAL COMPANY
26 THAMES STREET NEW YORK CITY

THE ACME RIGID H. S. EXPANDING BLADE SHELL REAMERS

You can spend two hours of a tool-maker's time underlaying blades and grinding reamers down to size for every few hours' use if you want to. With the Acme reamers ninety per cent of the time thus wasted is saved.

With the Acme reamers you can get an expansion as fine as .0005 in a few seconds, and a maximum expansion of the blades of $\frac{1}{8}$ ". When the blades are worn out they can be renewed.

Try an Acme against any reamer you have ever used and see the great difference in general efficiency and lower cost of maintenance. Write for an Acme bulletin today.



The Schellenbach-Hunt Tool Co., Cincinnati, O.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., London, England. Markt & Co., 193 West St., New York; Germany and Italy. New York Export and Import Co., 133-137 Front St., New York; China, Japan and Australia. Williams & Wilson, Montreal, Canada. J. S. Cock, Christiania, Norway.



Immediate Shipment



Seamless Tubing

STEEL—BRASS—COPPER—BRONZE

Shafting and Screw Steel

Springs Metal Stampings
Tungsten Hack Saw Blades
Cold Rolled Strip Steel
Annealed and Tempered Spring Steel
Wrought Iron Mouldings
Square and Rectangular Tubing
Tool and Alloy Steels
Magnet Steel



JULIUS BLUM & COMPANY

(KEYSTONE STEEL & TUBE CO., Inc.)

510-512 W. 24th Street, New York

Branches—Boston Chicago Pittsburgh Philadelphia
Buffalo Cleveland St. Louis Houghton, Mich. Denver, Colo.

GUARANTEED FORGINGS

for all

MACHINE PARTS

Wyman-Gordon Company

Worcester, Mass.

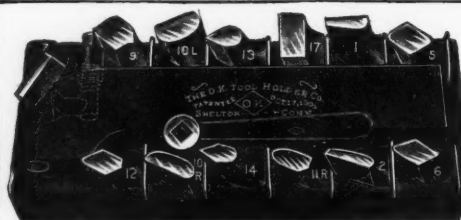
Cleveland, Ohio

PEERLESS High Speed Steel

Also full line of regular Crucible Steels
and Steels for special needs

Write us for particulars

HELLER BROS. CO., Newark, N. J.



**LATHE and
PLANER
TOOLS**

**THE O. K. TOOL
HOLDER CO.
Shelton, Conn.**

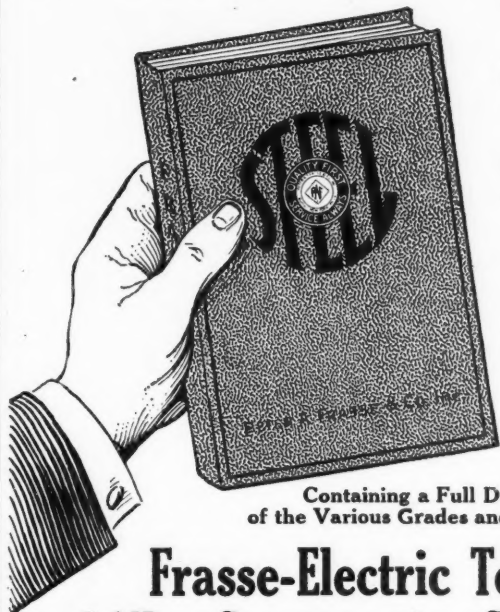
DROP FORGINGS

THE WHITMAN & BARNES MANUFACTURING CO.

ESTABLISHED 64 YEARS

1000 WEST 120th STREET, CHICAGO, ILL.

ASK FOR YOUR COPY—NOW!



100
Pages

Cloth
Bound

(Just
Issued)

Containing a Full Description
of the Various Grades and Finishes

Frassé-Electric Tool and Alloy Construction Steels

and many handy tables of value to steel users.

Write to our nearest office for a copy

PETER A. FRASSE & CO., Inc.
417-421 Canal St., NEW YORK

PHILADELPHIA (Works) HARTFORD BUFFALO
625 Arch Street 45 Boulevard 50-52 Exchange Street



FORGINGS—Big or Little

Johnston & Jennings forgings are always up to specifications. Regardless of the size of the forgings or of the order our facilities enable us to fill it on scheduled time and the quality of the finished product will never be sacrificed. Let us supply your requirements for high-grade forgings.

Estimates on receipt of specifications

The Johnston & Jennings Company
Addison Road and Lake Shore R. R. Tracks
CLEVELAND, OHIO

"Quality" Die Castings



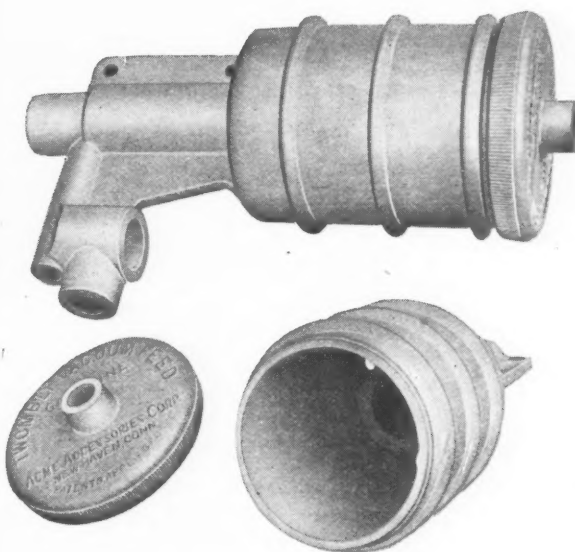
"We have a definite interest in the mechanisms for which we die-cast parts," says Mr. Micrometer.



The accuracy and economy of "Quality" Die Castings are contributing to the success of this pump cylinder, a device growing in popularity for gasoline vacuum systems in various types of automobiles.

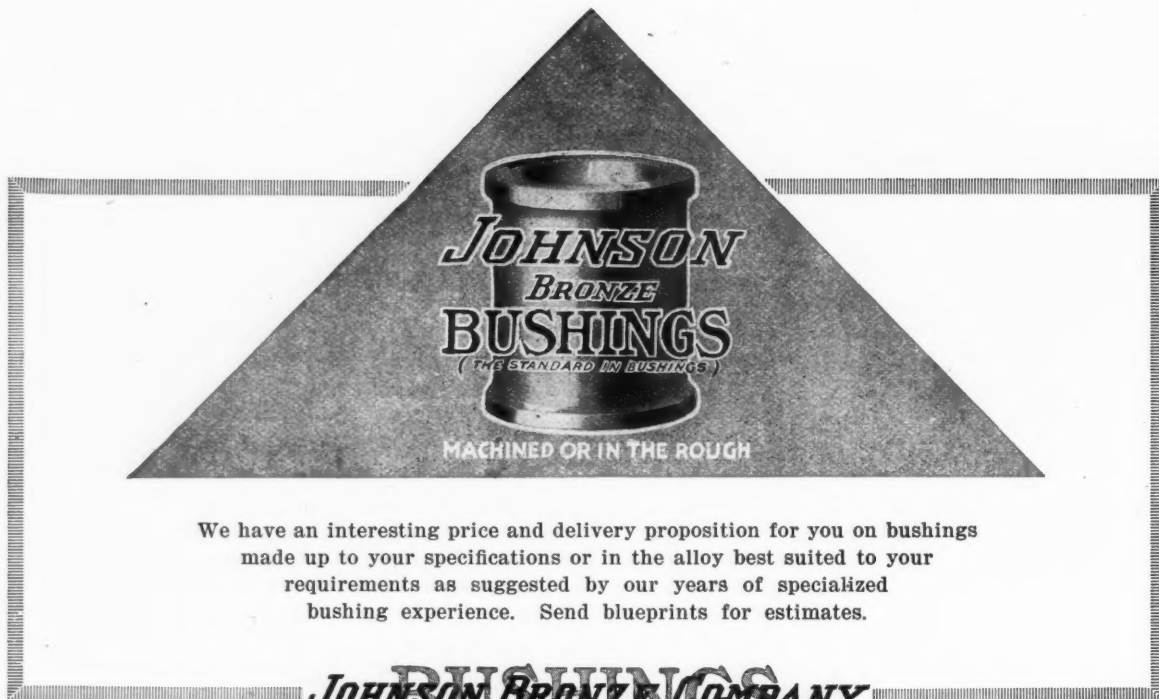
Perhaps you use parts that could be produced better and cheaper by our "Quality" automatic process.

Write us.



LIGHT MFG. & FOUNDRY CO.

Pottstown, Pa. U.S.A.
DETROIT OFFICE, PENOBSCOT BLDG.



**JOHNSON
BRONZE
BUSHINGS**
(THE STANDARD IN BUSHINGS.)

MACHINED OR IN THE ROUGH

We have an interesting price and delivery proposition for you on bushings made up to your specifications or in the alloy best suited to your requirements as suggested by our years of specialized bushing experience. Send blueprints for estimates.

JOHNSON BRONZE COMPANY

NEW CASTLE, PA.

Sales Offices: New York, Buffalo, Pittsburgh,
Cleveland, Cincinnati, Detroit,
Chicago, San Francisco.

*Bushing
Specialists.*

What DYSON Knows about Forging



Forging is like a lot of other things; the more you know about it, the better you do it.

There isn't anything Dyson doesn't know about forging; and he knows some things about combining metals and heat treating that nobody else does—it shows in his work.

That's why Dyson forgings are just a little better than any others.

We make any kind of castings, rough machined to your specifications—up to 5 tons. *Write for Estimates.*

JOSEPH DYSON & SONS, Cleveland, Ohio

MOLTRUP

IS NOW MAKING

Round Cold Drawn Steel

for Shafting, Screw Steel, etc.

It is made with the same careful precision that characterizes our

**HEXAGON, FLAT AND SQUARE
COLD DRAWN STEEL SHAPES**

*Finished Machine Keys—Machine Racks—
Flattened Ground Steel Plates and Discs.*

Moltrup Steel Products Co.

BEAVER FALLS

PA., U. S. A.

SALES AGENCIES

CHICAGO AND DETROIT....Central Steel & Wire Co.
NEW YORK.....George Nash Co.
BOSTON.....Edgar T. Ward's Sons
CHESTER.....Allison & Company
SAN FRANCISCO.....Milton Pray

MACHINERY FORGINGS

When you're in the market again for high-grade forgings let us show you why we should fill all your orders in the future.

We can make any forging that a manufacturer of machinery needs, and have the facilities to insure prompt deliveries regardless of the detail of specifications. We offer choice of material and finish and you'll find our prices right.

*Let us quote on
that next order.*

The Machinery Forging Company

Hamilton Ave. and Marquette St.
CLEVELAND - OHIO, U. S. A.

No. 10 BRONZE

For Grinder, Lathe and other
Machine Tool Bearings

Booklet upon request.

Lumen Bearing Company
BUFFALO, N. Y., U. S. A.

Established 1902

MOBERG DIE CASTINGS

We do not claim to be the only die casting concern in the country, but have customers who say we are.

C. J. MOBERG, Inc., Beach St., Mt. Vernon, N. Y.


FLEXIBLE STEEL TUBING

For Supplying Lubricant to Machine Tool Cutters

Strong, durable and warranted tight. No packing. All steel construction. Made in sizes $\frac{1}{8}$ to $\frac{3}{4}$ ".

We are supplying many big machine tool builders—why not you? Write for details and samples.

WHELOCK MFG. CO., Wheelock, Vt.



The price of tin has been skyrocketing for some months, and its rise does not seem to be spent.

Present purchasers of Genuine Babbitt Metal are obliged to pay an almost prohibitive price.

This is reason enough for you to get acquainted with Ajax Bull Babbitt, even if it did not have greater anti-frictional qualities, if it did not wear longer, and if it were not sold at a much lower figure.


Write now for an introduction, and remember that it will be to the advantage of your purse.

THE AJAX METAL COMPANY
Established 1880

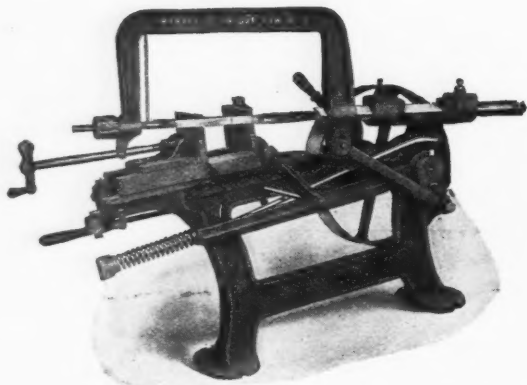
Main Office and Works, Philadelphia, Pa.
Southern Plant, Birmingham, Ala.

OFFICES

New York	Boston	St. Louis	San Francisco
Chicago	Washington	Pittsburgh	Detroit



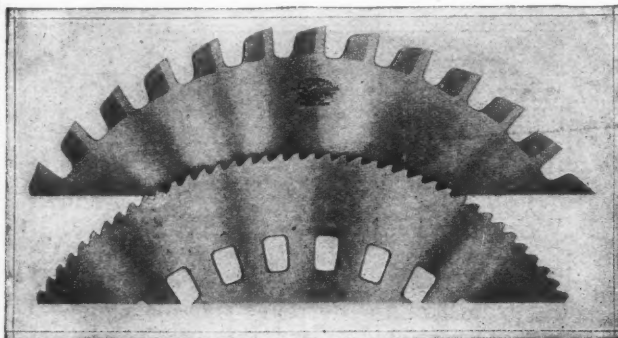
Marvel Draw Cut Hack Saw No. 2



Strong and rigid in construction, accurate, fast and economical in operation. Provided with adjustable stroke, quick-action heavy swivel vise that swivels both ways, automatic stop, means for taking up wear, etc. Capacity on long stroke, 6" by 6"; on short stroke 8" by 8". Blades 12" to 17". One of the most profitable machines of its class from every standpoint, and very moderately priced. *Details in catalog.*

Armstrong-Blum Manufacturing Company
343 North Francisco Avenue
CHICAGO ILLINOIS, U. S. A.

ATKINS METAL SAWS



We make them for every purpose—hot or cold cutting, and for all makes of machines.

The economy of their use is worth your investigation.

Write for Metal Saw Treatise "M."

E. C. ATKINS & CO., Inc.

The Silver Steel Saw People.
Home Office and Factory - Indianapolis, Ind.
Canadian Factory - - - - - Hamilton, Ont.
Machine Knife Factory - - - - - Lancaster, N. Y.

Branches carrying complete stocks in all large distributing centers, as follows:

Atlanta,	Minneapolis,	Portland, Ore.	Vancouver, B.C.
Chicago,	New Orleans,	San Francisco,	Sydney, N. S. W.
Memphis,	New York City,	Seattle,	Paris, France.

The HIGLEY COLD METAL SAW

Catalog furnished by

Vandyck Churchill Co.
New York Philadelphia Pittsburgh New Haven

SHAPERS EXCLUSIVELY

12" to 32" Stroke

SMITH & MILLS CO. CINCINNATI, OHIO, U. S. A.

FOREIGN AGENTS: C. W. Burton,
Griffiths & Co., London. G. & F.
Limbourg Freres, Brussels. Van
Rietschoten & Houwens, Rotterdam.
Glaenger, Perreaud & Thomine,
Paris. Stussi & Zweifel, Milan.

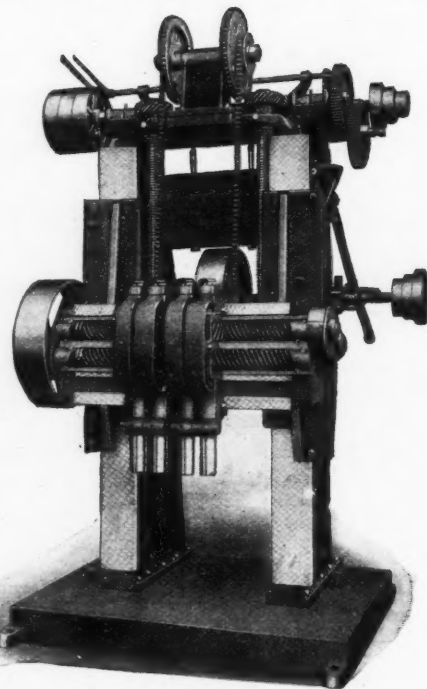
A "HARTFORD" Die Filing Machine

accomplishes many times more work than hand filing, at the same labor cost, and does it with greatest accuracy. More details on request.

THE ROBINSON TOOL WORKS, Inc.
Waterbury, Conn., U. S. A.



The "HOLE HOG" Line

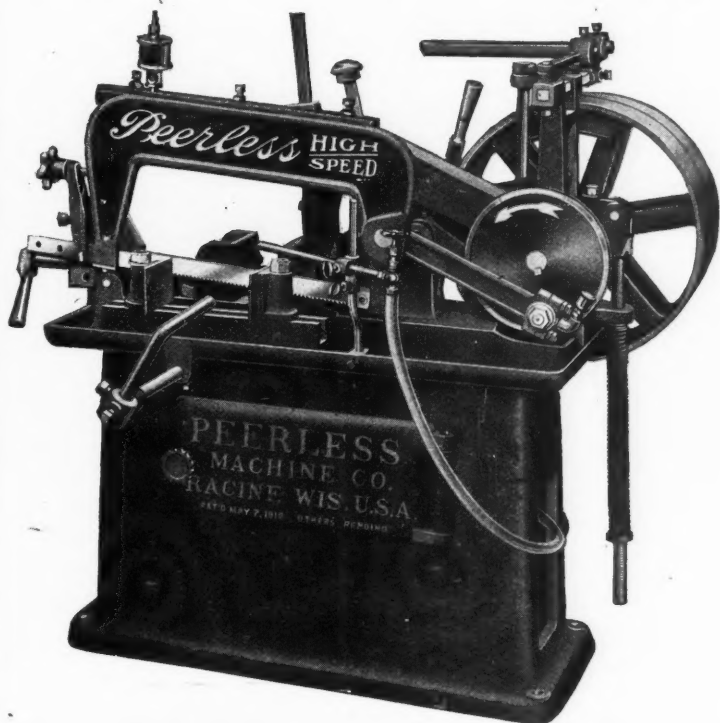


No. 7 D CYLINDER BORER

The type you need for progressive manufacturing of truck and tractor motors.

MOLINE TOOL CO., Moline, Ill.
MULTIPLE DRILLING AND BORING MACHINERY

Have You Ever Stopped to Consider—



Saving only 1/16" on each cut that 50 lbs. of material are saved on 100 cuts of 6-in. round, or 200 lbs. on 12 in.?

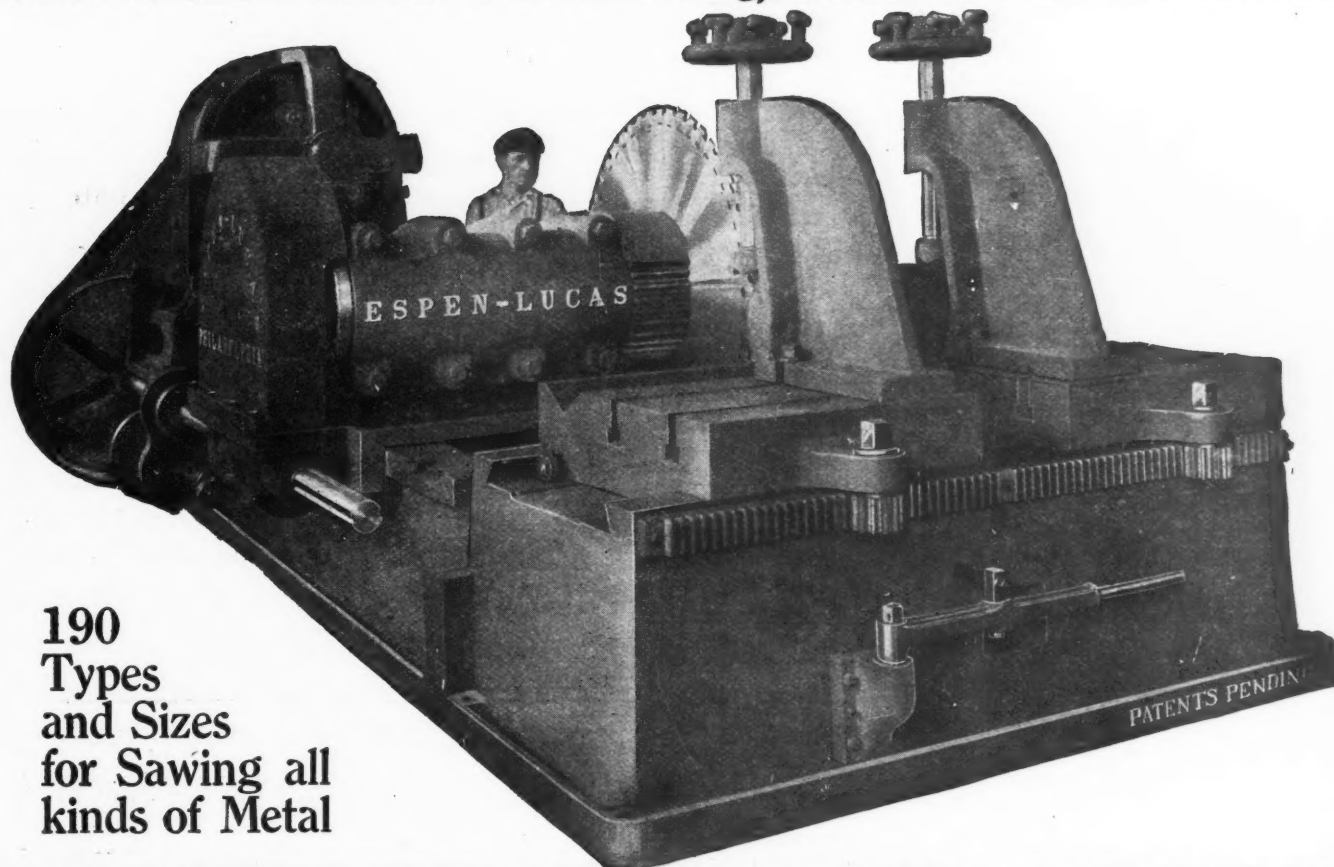
Chances are your savings would be several times this, depending on your cutting-off equipment. At the present high cost of material this saving would pay for a Peerless High Speed Heavy Duty Metal Cutting Saw in a remarkably short time.

After an actual test, some of the largest manufacturers have repeated their orders, and among them were concerns that heretofore had been unable to obtain satisfactory results from this type of cutting-off machinery.

The beauty of our proposition is—you can try this machine out for thirty days under your own conditions, if it does not come up to your expectations we will gladly take it back and pay the freight both ways.

PEERLESS MACHINE CO., 1611 Racine St., RACINE, WIS.

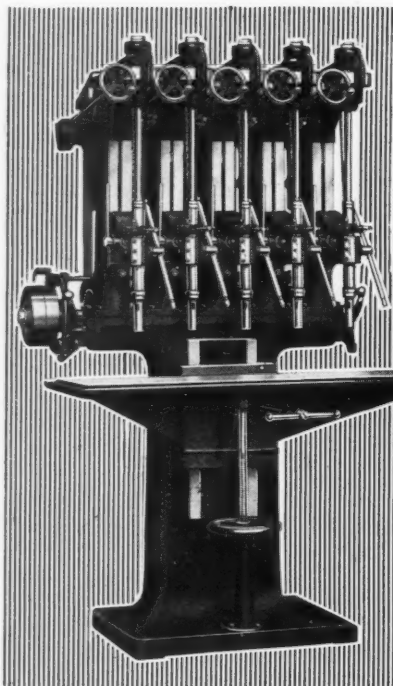
One of the Fastest Cold Sawing Machines in the World



**190
Types
and Sizes
for Sawing all
kinds of Metal**

**THE ESPEN-LUCAS MACHINE WORKS, Front and Girard Avenues
PHILADELPHIA, PA.**

HENRY & WRIGHT Drilling Machines



Lower cost with lighter construction yet ample rigidity make this machine a favorite for drilling holes $\frac{1}{2}$ " in diam. or less.

Class K
Number 5

The Henry & Wright Mfg. Co.
Hartford, Conn.



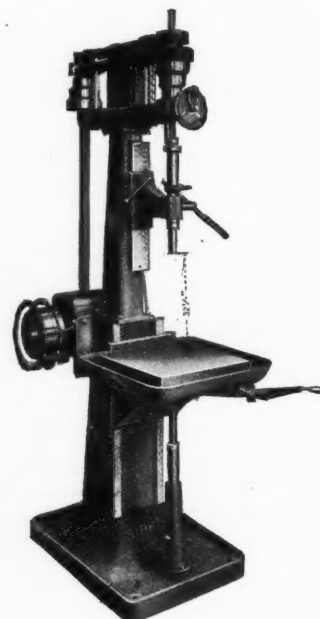
FEATURES

Quick Change Speed
Change in 2 seconds

Most Efficient Drive
No belt troubles.

Safety First
All parts protected

Heaviest Drill Made
Yet very sensitive
All Ball Bearings



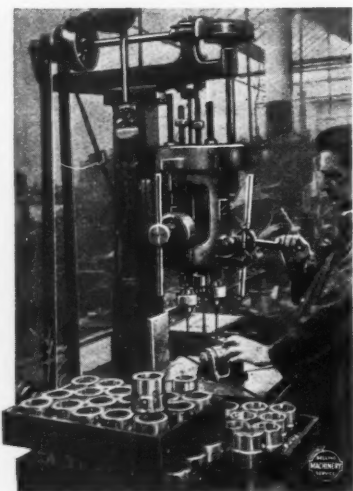
The Right Speed

You get accuracy and bigger output with

The Sipp Quick-Change-Speed Drill

because the speed can be changed in two seconds, hence the right speed for the job will naturally be used. *Write for Bulletin No. 4.*

THE SIPP MACHINE CO., Paterson, N. J.



"Accuracy First"

and the

TURNER TURRET

In one of the big shops at Greenfield, Mass., precision drilling, reaming, tapping, etc., are handled on the Turner Turret in a manner that satisfies the demand for accuracy and throws in speed for good measure. On the Turner Turret illustrated the operator is drilling die heads, one hole two diameters, one of which is also reamed. The three tools are indexed automatically, completing the operations and putting through the entire lot in remarkably fast time.

The Turner Turret saves 30 to 60 per cent of time and economizes labor—therefore reduces costs. And it's a mighty wide range machine.

Write for Complete Catalog

Turner Machine Company

DANBURY, CONN. and NEWARK, N. J., U. S. A.

Incorporated with Turner, Atherton & Co., Ltd.
Denton, Manchester and Stockport, England.



THE LINDGREN 13-Inch High Speed Drill

All bearings are bronze bushed and provided with ring oilers. The spindle has ball thrust bearings. The sleeve is graduated in inches.

*New lubrication features
No leakage of oil*

F.W. LINDGREN CO.
ROCKFORD ILLINOIS, U. S. A.

Radial Drills, High Speed Sensitive and Plain Radial Drills

Manufactured in sizes 2½, 3, 3½ and 4 foot by

THE CARLTON MACHINE TOOL CO.

*Successors to
The William E. Gang Company, Cincinnati, Ohio*

JOHNSON 14" SENSITIVE DRILL

A most practical machine for the purpose for which it was built—to drill 9/16" holes and under with speed and accuracy that make for greatest efficiency. The "Johnson" spindle and the other features of construction will interest you. Ask for details.

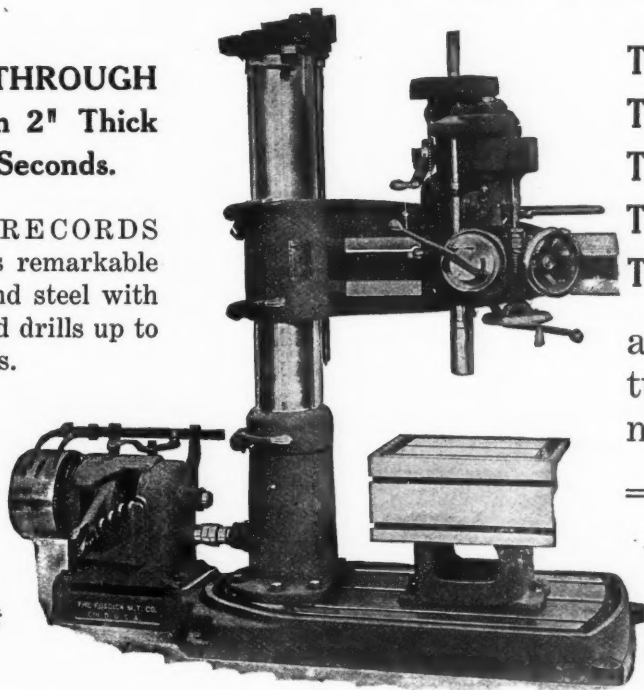
Johnson Machine Tool Co., Gouverneur, N.Y.

FOSDICK 2 and 2½ FT. HEAVY DUTY RADIALS

1" Drill THROUGH
Cast Iron 2" Thick
in 7 4/5 Seconds.

OTHER RECORDS
equally as remarkable
in iron and steel with
high speed drills up to
2½ inches.

*Send for
drilling
and
tapping
test sheet*



The INTERCHANGEABLE DRIVE
The EXTRAORDINARY POWER
The LUBRICATING SYSTEM
The HARDENED BEVEL GEARING
The BRONZE BUSHINGS

and many other valuable features will be found in these machines.

**THE FOSDICK MACHINE
TOOL COMPANY**

CINCINNATI, OHIO, U. S. A.

AGENTS: Biggs-Watterson Co., Cleveland, Ohio. Colcord-Wright Mch. & Supply Co., St. Louis, Mo. Eccles & Smith Co., San Francisco, Cal., Los Angeles, Cal., Portland, Oregon. Fairbanks Co., New York City, N. Y., Hartford, Conn., Albany, N. Y. E. A. Kinsey Co., Cincinnati, Ohio, Indianapolis, Ind. J. L. Osgood, Buffalo, N. Y. Peninsular Machinery Co., Detroit, Mich. H. A. Smith Machinery Co., Syracuse, N. Y. Swind Machinery Co., Philadelphia, Pa. Somers, Fidler & Todd Co., Pittsburgh, Pa. Stocker-Rumely-Wachs Co., Chicago, Ill., Milwaukee, Wis. Taylor Machinery Co., Boston, Mass. A. R. Williams Machinery Co., Ltd., Toronto, Ont., Canada. Burton Griffiths & Co., London, England. Fenwick Freres & Co., Paris, France. Wynmalen & Hausmann, Rotterdam, Holland. Rylander & Asplund, Stockholm, Sweden. Wilh. Sonesson & Co., Malmö, Sweden, Copenhagen, Denmark. Roku Roku Shoten, Tokyo, Japan. R. L. Scrutton & Co., Sydney, Australia.

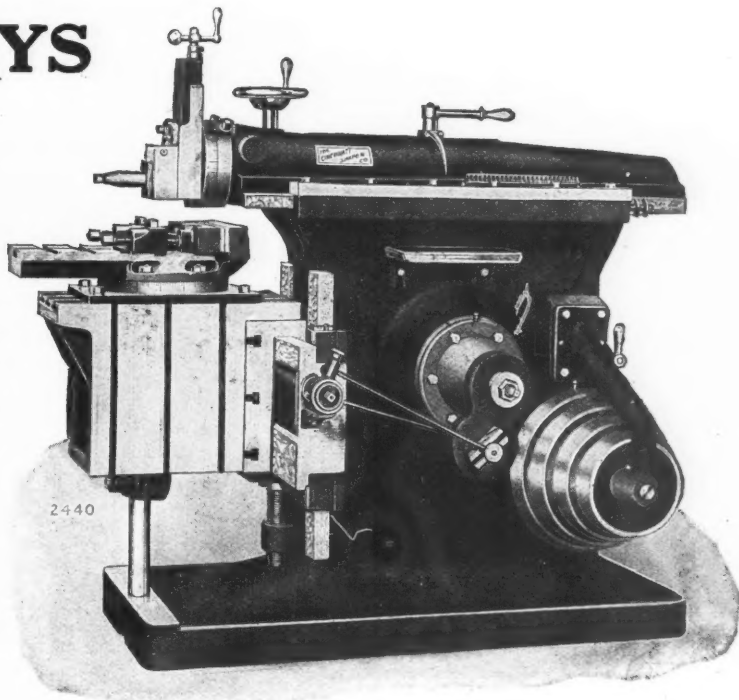
CHILLED WAYS

Are now being made for the Ram
Bearing in the Column on all

Cincinnati Shapers

This EXCLUSIVE feature, being used by us, together with SQUARE WAYS with SIGHT FEED OILERS and FULL LENGTH TAPER GIBS endwise adjustable by SINGLE SCREW for taking up wear, are a few of the characteristics that place CINCINNATI SHAPERS in a class by themselves.

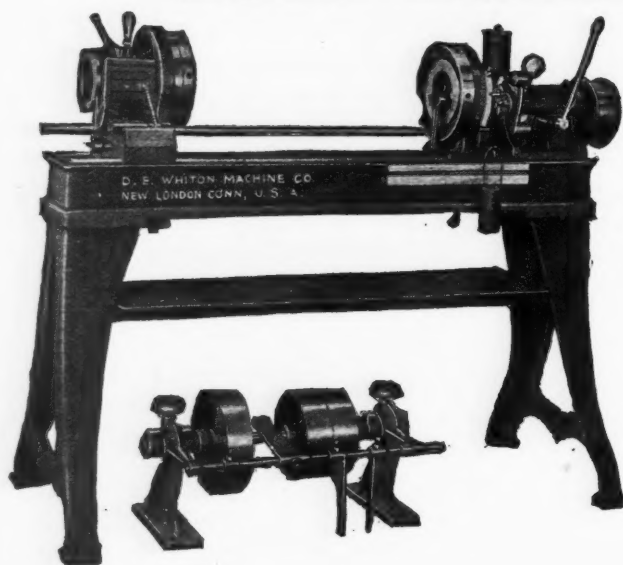
Catalog G upon request.



THE CINCINNATI SHAPER COMPANY
CINCINNATI, OHIO

THE WHITON REVOLVING CENTERING MACHINE

FOR ACCURATELY CENTERING FINISHED SHAFTS

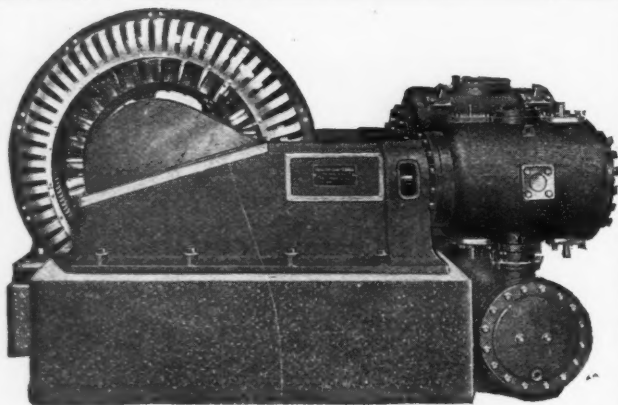


The cut shows new **Revolving Centering Machine**—a large size of the well-known machine of this type. It is heavier throughout and has capacity to center shafts up to 5 inches in diameter.

Constructed same as the smaller machine and embodies all the special features.

Circulars and prices sent upon application.

THE D. E. WHITON MACHINE COMPANY
NEW LONDON, CONNECTICUT, U.S.A.



LAIDLAW Feather Valve COMPRESSORS

For Operating Air Drills
and Pneumatic Tools

Include features which greatly increase the return on your compressor investment.

Laidlaw Feather Valve Air Compressors have established notable records for low operating costs.

Described in detail in Bulletin L530. Write for a copy.

WORTHINGTON PUMP AND MACHINERY CORPORATION

115 Broadway
New York

Laidlaw Works:
Cincinnati, Ohio

Branch Offices in All Principal Cities L 238.2

MERRELL Pipe Threading and Cutting Machinery.

Hand or Power Operated

THE MERRELL MFG. CO.
15 CURTIS STREET TOLEDO, OHIO

ARMSTRONG

Genuine
Stocks and
Dies



Pipe Threading
and Cutting-Off
Machines

Our dies can be adjusted to the variations in the size of fittings. They can be worked with less labor and the desired result accomplished in less time than with other dies. They are interchangeable in the stock, sharpened without drawing the temper, easily adjusted and kept in condition. Page 29 of our catalog gives you the details regarding our Pipe Threading and Cutting-off Machines. Sent on request.

THE ARMSTRONG MFG. CO.
297 Knowlton Street BRIDGEPORT, CONN.

Standard Wieland 6-inch
Pipe Threader and Cutter



Thread Pipe Do You? How?

The modern, efficient way is the Standard Wieland way, with a heavy, sturdy, durable machine, simple and positive in operation, fast and accurate in production. This machine costs more and is worth it; character and quantity of output prove it.

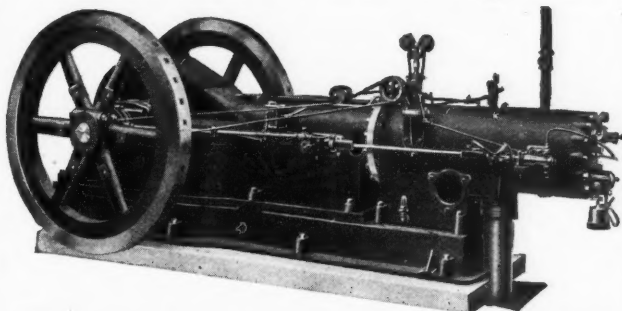
A few features: One-piece bed; single-speed pulleys; gear speed changes through semi-steel cut gears; deep chasers, cutting long taper threads in one cut perfectly, steel as well as iron pipe.

Send for the circular.

Standard Engineering Company
Ellwood City Pennsylvania

San Francisco Office; 1801 Claus Spreckels Bldg.

Much Power for Little Money CAN BE OBTAINED FROM Giant Fuel Oil Engines



Will operate air compressors, generators, hoists, pumps and machinery of all kinds. Runs on Fuel Oil, Star Oil, Calol, Stove Oil, Solar Oil, Diesol, Kerosene, etc.

Made in sizes 20 to 160 horsepower
Single or Duplex

We also manufacture Chicago Pneumatic Simplate Valve Compressors in 300 sizes and styles, Hummer Hammer Self Rotating Rock Drill, Little Giant Drills, Boyer Hammers and Duntley Electric Tools.

Ask for Bulletin 34-W

CHICAGO PNEUMATIC TOOL COMPANY

1060 Fisher Bldg.
CHICAGO

52 Vanderbilt Ave.
NEW YORK

Branches Everywhere

G-3

A Machinery Finish for Every Need

The Glidden Varnish Company.
Cleveland, Ohio.

GLIDDEN
Machinery Finishes



Rockwell Furnaces

FOR

ANNEALING
FORGING

HARDENING
HEAT-TREATING

MELTING
TEMPERING

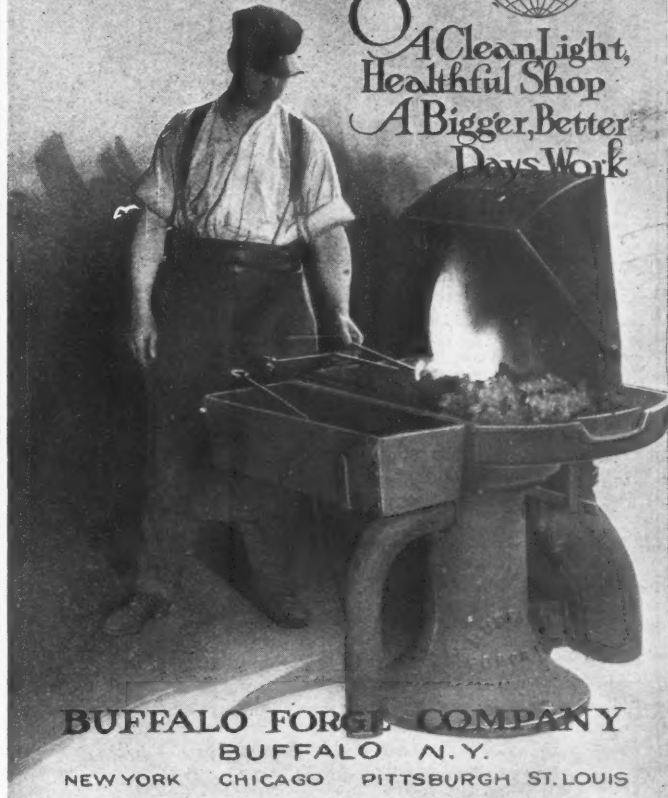
Write for Catalog 21

W. S. ROCKWELL CO., 50 Church St., New York

"Buffalo" DownDraft Forges

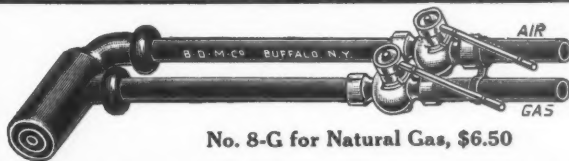


A Clean Light,
Healthful Shop
A Bigger, Better
Days Work



BUFFALO FORGE COMPANY
BUFFALO N.Y.

NEW YORK CHICAGO PITTSBURGH ST. LOUIS



No. 8-G for Natural Gas, \$6.50

PREHEATING BLOWPIPES

The two most essential points in welding are:

FIRST: The use of a proper sized oxy-acetylene flame

SECOND: The saving of gas by preheating your work for the oxy-acetylene flame.

The first is under your control in the use of the oxy-acetylene apparatus you have selected.

The second we can aid you in by supplying the proper blowpipe for preheating purposes.

We manufacture blowpipes for use with Coal Gas, Natural Gas, Gasoline Gas and Acetylene Gas, with Air Blast.

Our catalog "B.M.," free for the asking, contains full description and prices. WANT ONE?

BUFFALO DENTAL MANUFACTURING CO., Buffalo, N. Y., U. S. A.

THE SAUNDERS— for Quick and Accurate Pipe Threading and Cutting

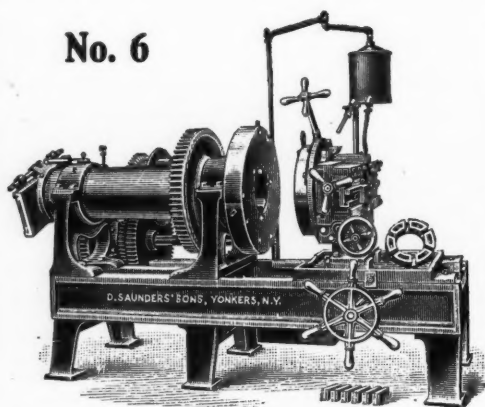
Saunders No. 6 is built for business and embodies every facility for quick and accurate service.

Special gearing gives ample power, without large pulleys and tight belts. Cone pulleys and interchangeable gearing—controlled by lever—vary speeds according to sizes to be cut. The adjustable die head—our patent—with interchangeable chasers, threads from 2½ to 8 inches and releases pipe without stopping or reversing the spindle. There are no complicated attachments—the whole mechanism is direct and easy to operate.

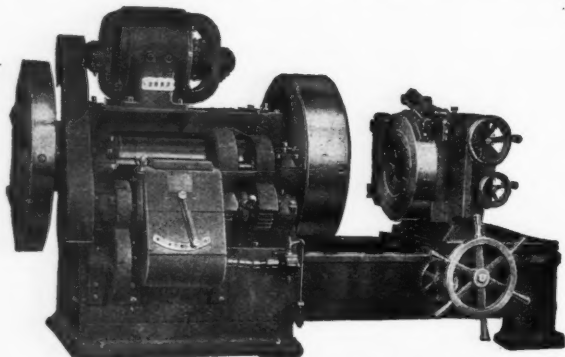
Complete Description in Catalog "P."

D. SAUNDERS' SONS, Yonkers, New York

No. 6



The Method of Drive is an Important Thing in a Pipe Machine



Because a lot of time is wasted if the speed is not just right for every size and material of pipe.

The "Stoever" Pipe Machine

has a single-pulley drive with gear speed variation. This means that the belt speed is constant, not lowest when it should be highest. The belt tension is always proportional to the power transmitted—economy of power. The belt contact is constant and always adequate.

The "Stoever" has a friction countershaft which eliminates shifting belts and saves at least one-third in belting cost.

The gear speed variation affords a speed exactly right for every size of pipe, and for iron or steel. This means maximum cutting and threading speed.

Write for the "Economy" Booklets.

TREADWELL ENGINEERING CO.

Sales Office: 140 Cedar Street, New York

Works: Easton, Pa.

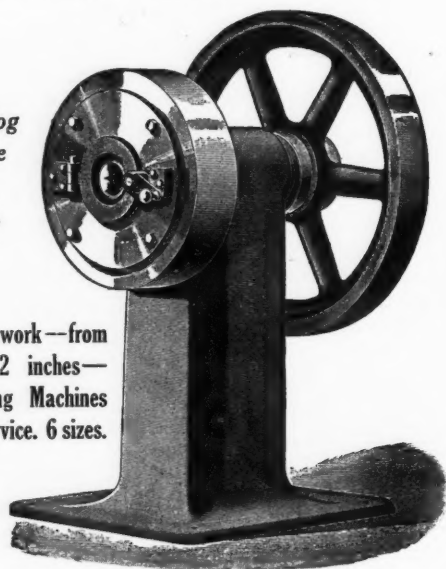
T E 1v

SAVE METAL—

Swage Your Rods and Tubes

Perhaps you have never considered the amount of metal wasted cutting and grinding stock to form. Swaging eliminates this waste and is a process which actually makes the metal stronger and more durable.

*Our Catalog
is Complete
and
Interesting.*



For all small work—from
.015 up to 2 inches—
Dayton Swaging Machines
give the best service. 6 sizes.

THE EXCELSIOR NEEDLE CO., Torrington, Conn.

Coventry Swaging Co., Ltd., White Friars Lane, Coventry, England, Agents for Great Britain. Fenwick Freres & Co., 8 Rue de Rocroy, Paris, France, Agents for France, Italy, Belgium, Spain, Portugal and Switzerland.

The "Forbes" for Better Thread Cutting



Every user of "Forbes" Machines is firmly convinced that they handle pipe cutting and threading easier, quicker and more accurately than any similar machine. The "Forbes" doesn't have a lot of extra parts; it is complete in itself, can be moved readily from one place to another, has interchangeable parts and adjustments for wear. By reason of these advantages and the exclusive "Forbes" feature of revolving the dies instead of the pipe, one man can easily cut off and thread pipe up to 15" in diameter.

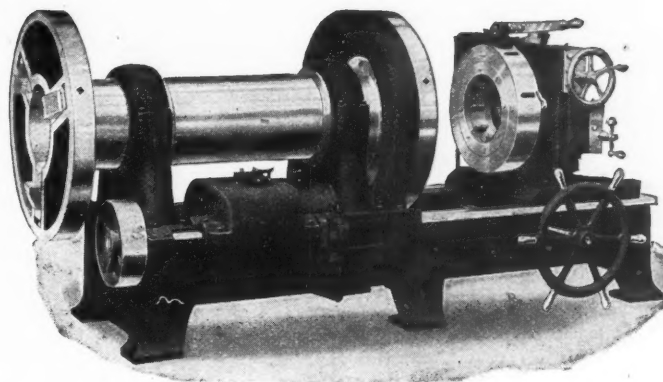
Full line of "Forbes" machines in catalog.

THE CURTIS & CURTIS COMPANY
8 GARDEN STREET
BRIDGEPORT, CONN.

PEERLESS
B&K
DUPLEX P.D.Q.C.

PEERLESS
B&K
DUPLEX P.D.Q.C.

PIPE THREADING



DON'T handicap your men with poor tools. Give them pipe machines that can be operated easily and quickly, and with the assurance that the threads will be good. Beveled, high speed steel cut-off tool, speed change gear-box, rotary oil pump and the Peerless Die-head all go to make up a dependable, lasting pipe machine.

Send for the catalog

BIGNALL & KEELER MACHINE WORKS, Edwardsville, Ill.

PEERLESS
B&K
DUPLEX P.D.Q.C.

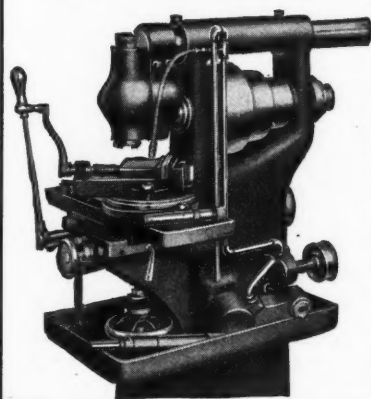
PEERLESS
B&K
DUPLEX P.D.Q.C.

Smalley-General Thread Millers

**For Shells and
General Use.**

SMALLEY-GENERAL COMPANY
BAY CITY, MICHIGAN

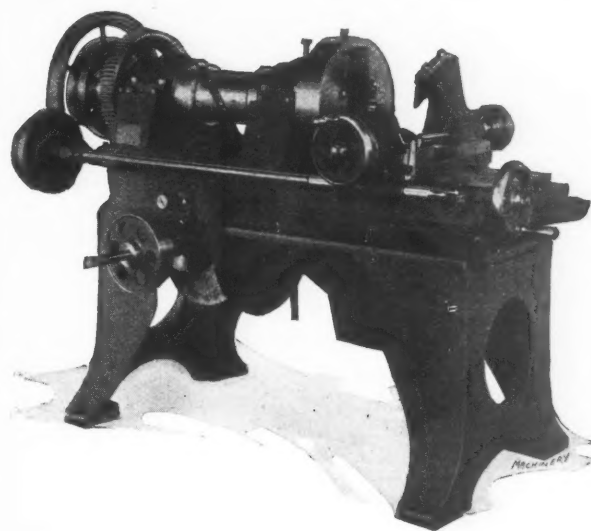
BICKFORD MILLER



Small machine; big range. Does both horizontal and vertical milling on medium and small work and is a star at light finish cutting on duplicate parts. It is accurate, speedy and the easiest kind of a machine to operate. If you are looking for big output on light work, buy a "Bickford."

Write for details

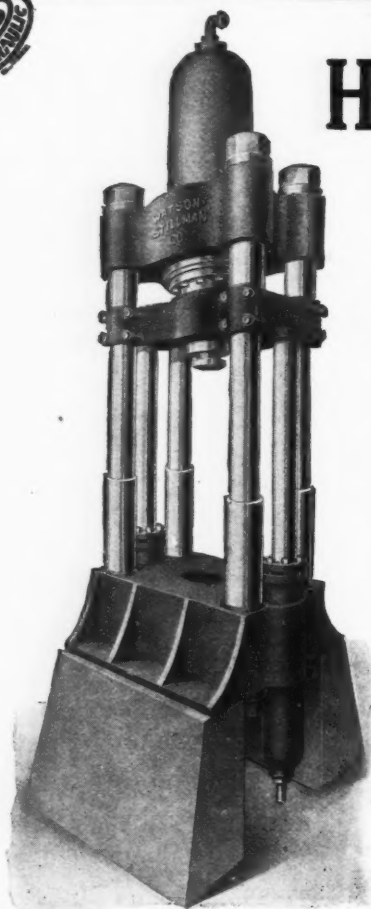
BICKFORD MACHINE CO.
GREENFIELD MASS.



Speed Up your Stock Cutting

The Hurlbut-Rogers Two-tool Cutting-Off Machine will do it. It's a machine of great strength and power, holds stock rigidly, stands hard driving. Cuts are taken in half the time required for a single tool machine. H-R accuracy, speed and ease of operation are trump cards in the game of rapid production. Capacities up to 10".

THE HURLBUT, ROGERS MACHINERY CO.
South Sudbury, Massachusetts



600 Ton Hydraulic Press
For Piercing Steel Billets



HYDRAULIC MACHINERY



We are prepared to furnish complete hydraulic plants from pump to press, Valves, Fittings, Accumulators, Benders, Shears, Bulldozers, Riveters, Straighteners, Presses for every purpose, as well as a large number of machines for special operations.

The press shown here is designed to pierce steel billets and other heavy forcing. It is a fast working press, the ram being returned by two cylinders.

The Watson-Stillman line is the result of nearly 70 years' continuous effort in the development of hydraulic equipment.

We invite you to consult with our Engineering Department. It will gladly solve your hydraulic problem.

Write for Catalogs

THE WATSON-STILLMAN CO.

Engineers and Builders of Hydraulic Machinery

NEW YORK
192 Fulton Street

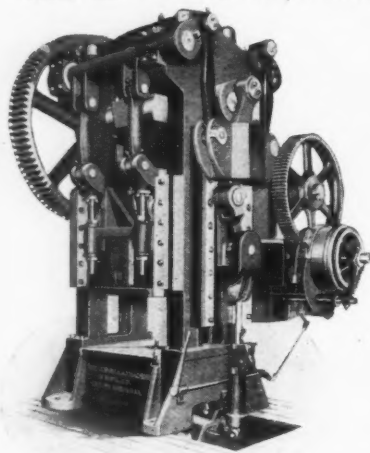
CHICAGO
McCormick Building

383



"CLEVELAND" TOGGLE DRAWING PRESSES

Perfect dwell and perfect timing—"Cleveland" Toggle Presses are unusually heavy in their proportions, and are built in all sizes—both single and



double crank, for the production of all classes of drawn sheet metal parts. They are equipped with automatic or hand operated multiple disc friction clutches. Yokes, rock shafts, cranks and links are steel castings. All pin bearings are bronze bushed.

Patent Applied for We are prepared to furnish complete equipments of Presses, Shears and Dies for the production of large or small sheet metal articles of every description.

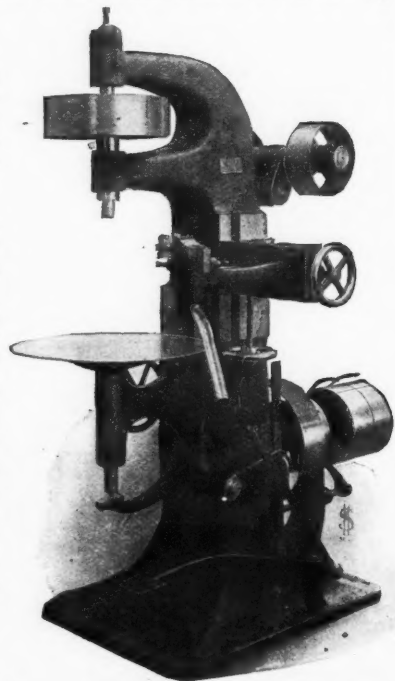
Send us your inquiries.

THE CLEVELAND MACHINE & MFG. CO.
4944 Hamilton Avenue
CLEVELAND OHIO, U. S. A.

SWAINE DOUBLE SEAMER No. 4

Belt pull is close to base; rigidity is built into the machine; vibration is practically nil.

The ease with which table is adjusted for various sizes of work, the precise alignment of upper and lower spindles are some of the features responsible for the efficiency and accuracy of this machine. There are other reasons also. A word from you will bring you our 200-page descriptive catalog.

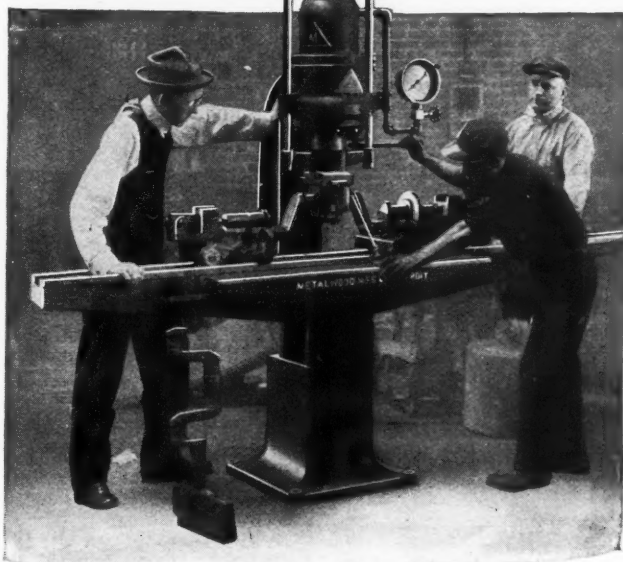


FRED. J. SWAINE MFG. CO.
7th and O'Fallon Streets ST. LOUIS, MO.
LARGEST PRESS BUILDERS IN THE WEST



Reg. U. S. Pat. Office

THE METALWOOD Crankshaft Straightening Press



This press is built in 20-ton and 35-ton sizes, and is particularly adapted for straightening crankshafts. Both sizes are made in three styles, for direct drive from accumulator line, with built-in pump for belt drive from line-shaft, also as a self-contained and movable unit. The straightening centers are adjustable for length and the steel tracks on which they travel are removable for wear. The machine is rapid in operation and a close degree of accuracy is obtainable through the prompt and exact action of the "Metalwood" Patent Operating Valve.

Let us send more detailed description

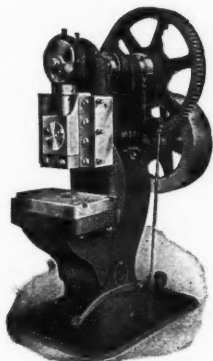
Metalwood Manufacturing Company, Detroit, Mich.

Designers and Builders of High Speed Hydraulic and Special Machinery for all purposes

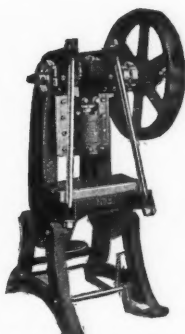
COMPLETE HYDRAULIC INSTALLATIONS.

R. E. Ellis Engineering Co., 549 Washington Blvd., Chicago, Ill., Sales Representatives. For Great Britain and Continent, address Gaston E. Marbaix, Coronation House, 4 Lloyds Ave., London, E.C., England.

Niagara Power Presses



Geared Punching Press



Inclined Power Press

No matter what your requirements may be, there's a Niagara to answer the call; any size, single and double action, single and double crank, up to 10' between housings.

Niagara Presses are all of extremely massive design and closely finished to the finest detail. Shafts are forged from high carbon steel, ways of slides and gibs are long and wide, slides are of box construction and ways well braced. Many other features fully described in catalog. Write.

Niagara Machine & Tool Works
BUFFALO, N. Y., U. S. A.

Hydraulic Presses and Pumps

WE specialize in them and build nothing else. Our plant was built, our machinery designed, our organization selected with no other end in view than manufacturing hydraulic press equipment to fit your pressing needs. That we have succeeded is evidenced by the fact that we are doubling our capacity to take care of the business coming to us.

The press shown here is designed for general forcing work in machine, railroad, automobile and repair shops. It is a particularly convenient press for general work and is only one from our extensive line.

Let us submit expert information on any type of hydraulic press for work such as forcing, forming, flanging, forging, drawing, baling, broaching, die, arbor, etc.; also hydraulic pumps. Write us today.

The Hydraulic Press Mfg. Co.

84 Lincoln Avenue

MOUNT GILEAD, OHIO

Branch Offices: Room

1105-R, 39-41 Cortlandt

St., New York City;

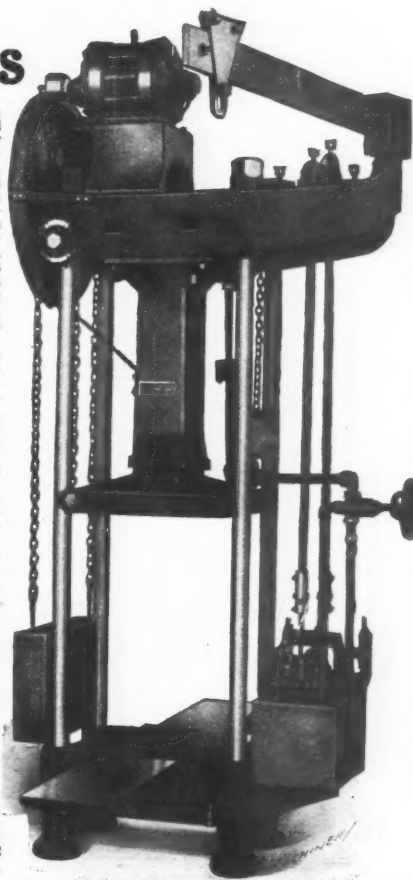
427-D Guardian Bldg.

Cleveland, Ohio;

Division B, 32

N. Clinton St.,

Chicago, Ill.



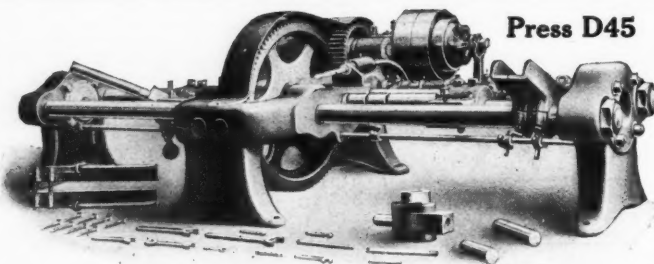
FERRACUTE PRESSES

For cutting, forming and drawing sheet metals
Hundreds of sizes and styles for every kind of work

Press D45 is a horizontal, double-ended screw press designed for deepening or redrawing sheet metal tubes and shells from 1 to 6 inches diameter and 18 inches deep. By using the automatically swinging punch, shown at the left, a depth of 24 inches is obtained. Five-inch steel rods take the tensile stresses. The steel screw is $6\frac{1}{2}$ inches diameter. Adjustable gravity-feed, let-off device. Weight about 16,000 lb.

Photographs and full information for the asking.

FERRACUTE MACHINE COMPANY, BRIDGETON, NEW JERSEY, U. S. A.

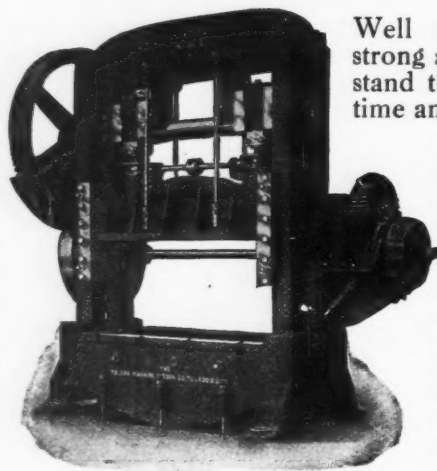


Press D45

Conspicuous and Compelling in Their
Superiority

THE "TOLEDO"

Double Crank Presses represent the
cumulative knowledge of the
Toledo organization



"Toledo" No. 95 E for forming and other operations on auto hoods, engine pans, bodies and seats, steel range and other heavy stamped and formed parts.

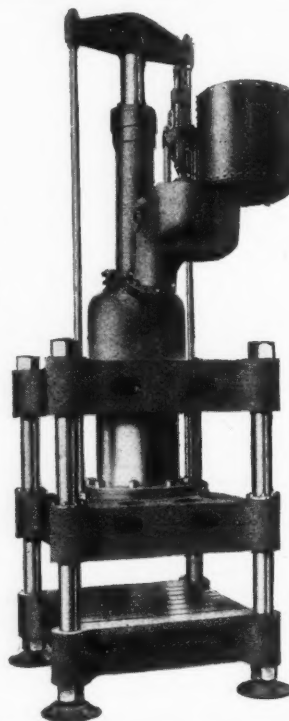
Over 250 sizes for every requirement of sheet metal and drop forged work.

Well proportioned, strong and rigid, they stand the acid test of time and service.

Hammer forged shafts, machine cut gearing well protected, massive connections heavily reinforced, long and wide slides of improved design and other dominant Toledo characteristics.

The Toledo Machine & Tool Co.
TOLEDO, OHIO, U. S. A.

200-500
Ton
Flanging
Press

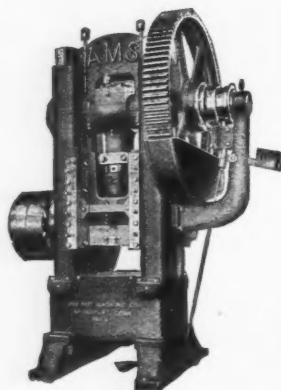


BETHLEHEM STEEL COMPANY

MACHINERY DEPARTMENT

ENGINEERS AND
MACHINERY BUILDERS

SOUTH BETHLEHEM, PENNA.



Press No. 580A

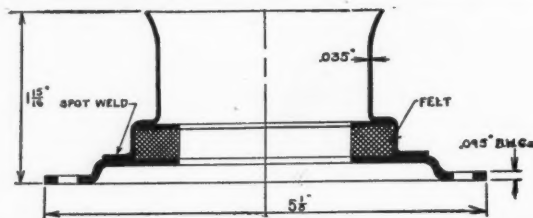
PRESSES

LARGE OR SMALL
REGULAR OR SPECIAL

"AMS"

Let us quote you on your
next press

**THE MAX AMS
MACHINE CO.**
BRIDGEPORT CONN.



Have You Ever Considered

That you might save money on some of the parts you use if you bought stampings instead of castings? You can, providing Acklin does the stamping. And you'll find, in addition, that Acklin Stampings are stronger and of greater uniformity.

Trial Order Brings Proof

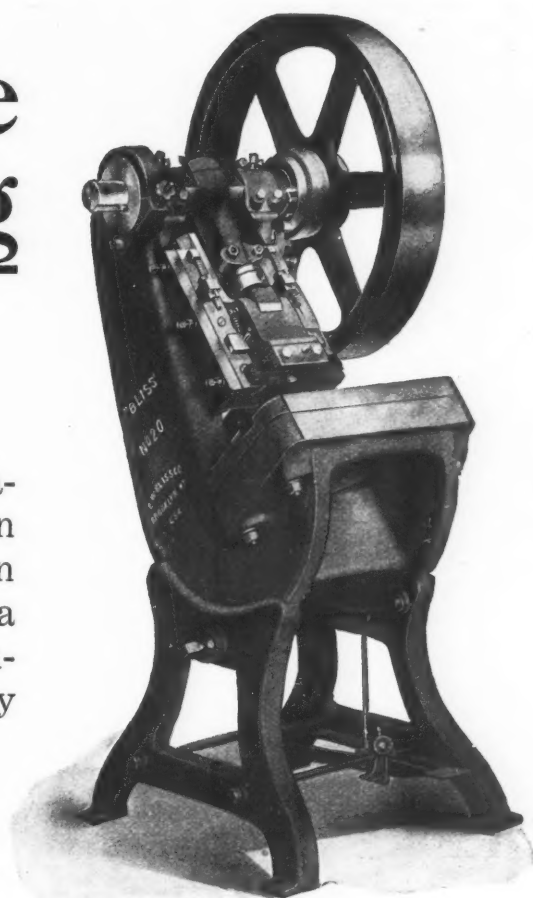
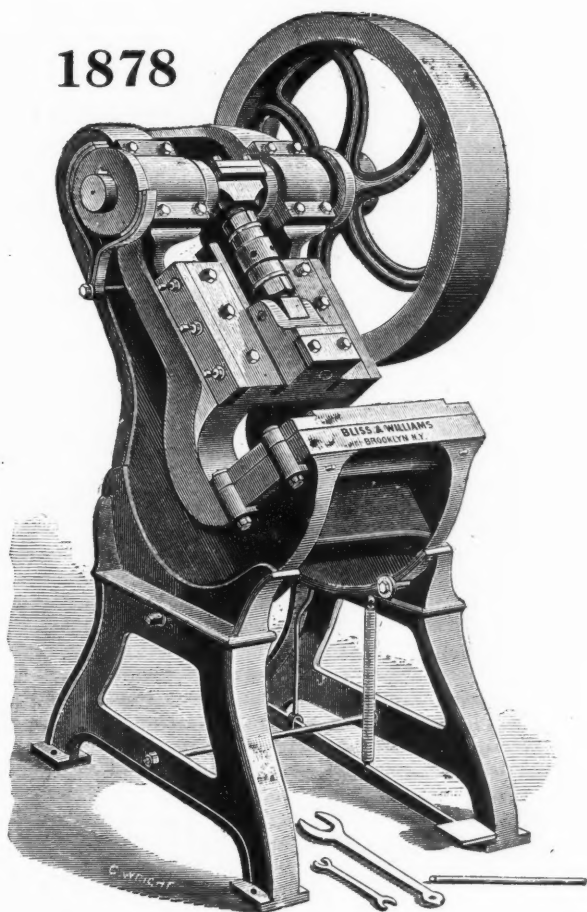
THE ACKLIN STAMPING CO., 1657 DORR ST.
TOLEDO, OHIO

Thirty-Nine Years Young

*"We built this Press RIGHT
in the beginning."*

IT is the exceptional thing in machinery manufacture that a design is so well conceived at its inception as to retain its original form over a long period of time. Still more unusual is a steady increase in popularity and demand.

1878



1917

"BLISS" INCLINABLE PRESSES

afford a striking example of this. Their adaptability to a wide range of work and their wonderful convenience and economy in operation have proved them the most practical of machine tools for manufacturing articles of sheet metal. They have been refined but not changed fundamentally. Their use has extended into so many new lines without imposing material change in design that they have become an accepted standard in the trade. We have devoted especial effort to standardizing their manufacture and providing every desirable improvement. "Section 2A" gives interesting and valuable information. Send for it.



1857

E. W. BLISS COMPANY

Main Office and Works: BROOKLYN, N. Y., U. S. A.

CHICAGO OFFICE
People's Gas Bldg.

DETROIT OFFICE
Dime Bank Bldg.

CLEVELAND OFFICE
Union Bank Bldg.

1917

LONDON, S. E., ENGLAND, Pocock St., Blackfriars Road.

PARIS, FRANCE, 100 Boulevard Victor-Hugo, St. Ouen.





Forging Thin Stock is Hard on a Hammer

Every time the ram of this Nazel Hammer descends, the punch and die come within $\frac{1}{8}$ " to $\frac{1}{4}$ " of meeting, the hammer itself absorbing much of the shock of the blow. William H. Horn & Bro., Inc., Philadelphia, have used this hammer constantly for four years on thin tool steel parts for surgical appliances. They say, "It hasn't cost us five cents for repairs."

It takes a hammer built and operated like the Nazel to stand work such as this. There's practically no limit to Nazel usefulness. Ask us questions.

NAZEL ENGINEERING WORKS, Philadelphia, Pa.

4043 NORTH 5th STREET



LITTLE GIANT POWER HAMMERS

Motor or Belt Driven.
250 lb. Ram. 200 r.p.m.

Machine gun rapidity and precision.

Sold on 30 days' free trial.

Prompt shipments.
Will easily forge stock $5\frac{1}{2}$ in. square or 7 in. round.

Special dies for any forging purpose.

Also made in 25, 50, 100 and 500 lb. sizes.

Upkeep expense averages less than $\frac{2}{5}$ of 1 per cent annually on all our hammers in use from first one sold 24 years ago to last one shipped.

LITTLE GIANT POWER HAMMERS are guaranteed forever against defective material and workmanship. Let us send you one on 30 days' trial. Write your jobber or direct to us.

MAYER BROS. CO.
131 W. Rock St., Mankato, Minn., U. S. A.

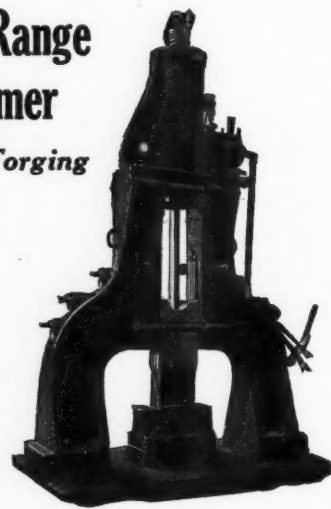


A Big, Wide-Range Steam Hammer

For Heavy Steel Forging

The Erie Double Frame Steam Hammer is the king of hammers for miscellaneous heavy forging. Force and rapidity of blows are easily controlled by hand lever, or hammer may be adjusted to deliver continuous strokes automatically.

Adapted for steam or compressed air as desired.



"OLD RELIABLE"

has Automatic Safety Stop and other safeguarding devices. Complete details on request.

ERIE FOUNDRY COMPANY
ERIE, PA., U. S. A.



A Service Hammer

Not only service that includes the work of the hour—but service that means years of hard, everyday work.

For nearly 50 years "Bell" Hammers have stood up under all manner of forging tests. They have proved themselves powerful, adaptable, enduring. "Bell" Hammers built 10 and 15 years ago are still giving uniformly good service, and the same will hold good with the models that are being marketed today.

The "Bell" Hammer operates rapidly, has a uniform stroke—meets conditions. Depreciation and upkeep almost negligible.

Our illustrated catalogue tells the whole story.



BUFFALO FOUNDRY & MACHINE COMPANY
10 Winchester Avenue BUFFALO, N. Y.

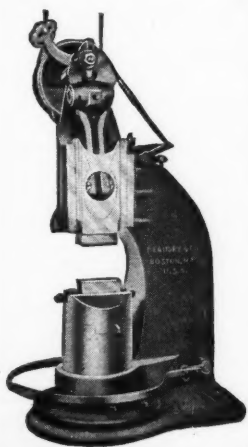
DROP PRESSES

for All Purposes Our Specialty

The Peck Drop Lifter
can be readily applied to
foot or hand drops.

MINER & PECK MFG. CO.

Proprietors of the PECK DROP PRESS WORKS
NEW HAVEN CONN., U. S. A.



BEAUDRY HAMMERS

For General Forging

Save Fuel, Time
and Labor. Cut Forging
Costs in Two.

Belt or Motor Driven

BEAUDRY & CO.

Incorporated
141 Milk St., Boston, Mass.

HIGH SPEED HAMMERS

For High Speed Work

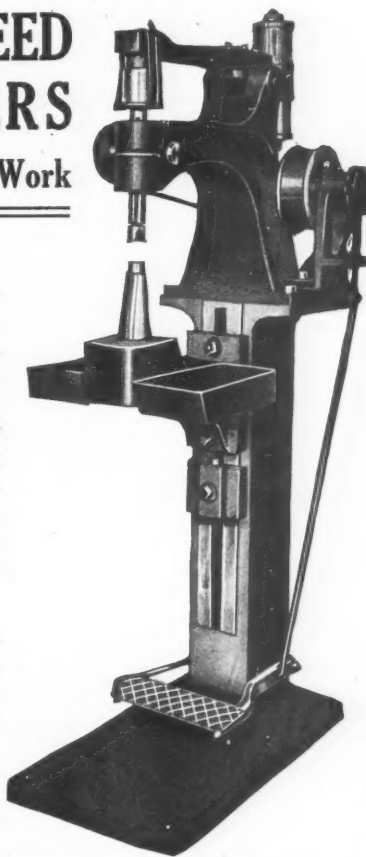
FEATURES:

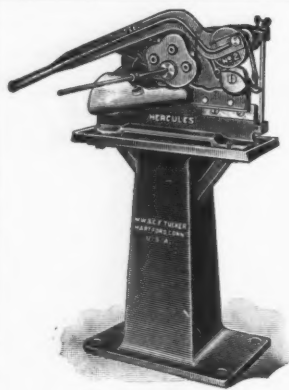
Economy in floor space, elimination of weight and a guaranteed saving of from 15 % to 20% on any class of work. The life of the machine is practically indefinite as phosphor bronze bushings are used throughout.

No riveting too intricate for us; no riveting which our machine cannot accomplish.

Send for our
High Speed Hammer
Book

THE HIGH-SPEED HAMMER CO.
ROCHESTER, N. Y.





Nos. 1, 2 and 5

Hercules Shears and Rod Cutters

In Six Sizes

Are preparedness tools in that they are always ready to do that job of sheet, bar and iron or soft steel rod cutting. No tools to adjust, belts to break, no drag on the power plant. Feed the material to the machine and work the lever with low cost labor. Rods can be cut with ends ready to thread, or spin over forming rivet head without additional machining.

The shear blades have a draw-in cut, with no tendency to crowd work out of the shear. Note that leverage is directly over the cutting point, also the steel band that raises the jaw, dispensing with all springs.

Send for Shear Catalog

Manufactured
and for sale by

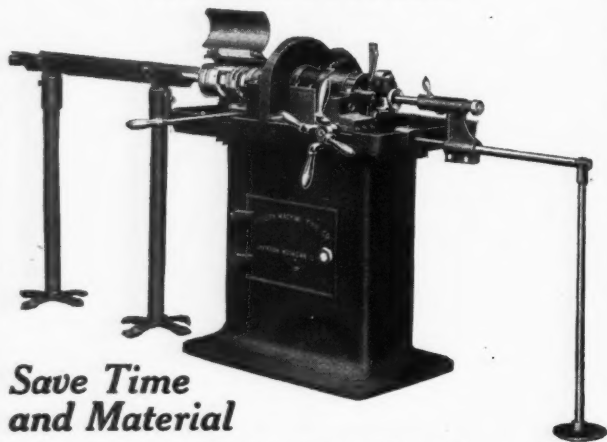
W. M. & C. F. TUCKER

HARTFORD, CONN., U. S. A.



Plain Shears—3 and 4

CUTTING-OFF MACHINES



**Save Time
and Material**

These two requirements of modern efficiency are satisfactorily met by the

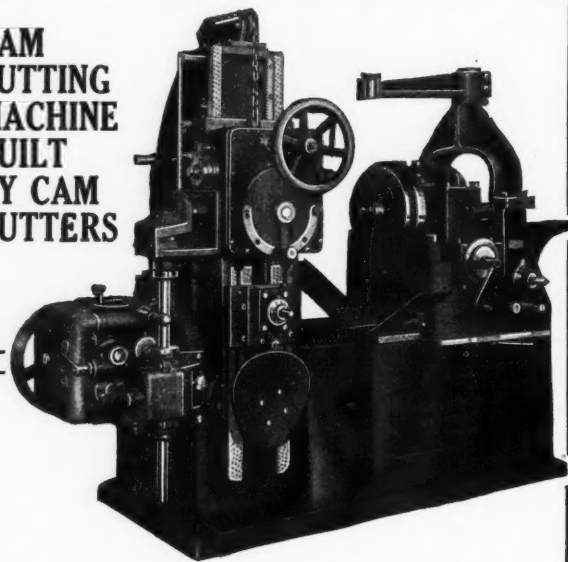
MODERN CUTTING-OFF MACHINE

A powerful back geared machine, especially designed for cutting off pipe, tubing and solid bars. Has been in constant use for over five years on heavy production work. For further information ask the

Modern Machine Tool Co.

JACKSON, MICHIGAN, U. S. A.

CAM CUTTING MACHINE BUILT BY CAM CUTTERS

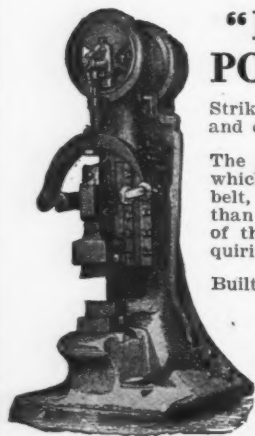


We have been cam cutters so long that we know all the requirements and difficulties of the business. This knowledge has enabled us to employ in the ROWBOTTOM VERTICAL HEAD CAM MILLER every facility for accurate, rapid and economical cam cutting.

If you use enough cams to make it pay you to cut them, send for particulars; if not—let us estimate on cutting them for you. Either way guaranteed mutually satisfactory.

The Rowbottom Machine Co.

WATERBURY FACTORY WATERVILLE, CONN. CONNECTICUT



"DEAD STROKE" POWER HAMMERS

Strike a square, true blow at all times and can be safely run at high speed.

The peculiar feature is the spring, to which the ram is attached by a flexible belt, permitting a far more effective blow than can be given by any other hammer of the same weight and stroke, and requiring less power.

Built in 7 sizes. Write for circulars.

MANUFACTURED BY
DIELT & EISENHARDT, Inc.
1304 No. Howard Street
Philadelphia, Pa., U. S. A.

CHAMBERSBURG STEAM HAMMERS

"All Sizes for Every Class of Work"

Our hammers are double acting, have simple valve gear and give the operator perfect control.

Write us for details.

CHAMBERSBURG ENGINEERING COMPANY, Chambersburg, Pa.

HYDRAULIC MACHINERY

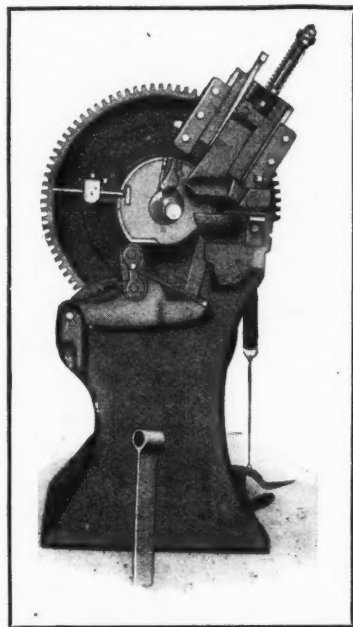


PRESSES—Foot and power.
WIRE FORMING MACHINES—Standard or special.

TUMBLERS—All kinds.
BALL BURNISHING EQUIPMENT.

BAIRD MACHINE CO.
BRIDGEPORT, CONN.

Power Eye Bending Machines



Exceedingly rapid and uniform production of eye bolts at a minimum expense of operation.

Built in sizes for bending stock up to 1½" in diameter.

Builders also of the Lynch Eye Bender.

Write for catalog describing the Moline Line of Punching, Shearing and Forging Machinery.

Williams, White & Co.

Moline, Ill.

Pittsburgh Office:
808 House Building

U.S.A.

Chicago Office:
933 Monadnock Block

New York Office: C. H. Holbrook, 30 Church Street

Detroit Office: J. C. Austerberry, 924 Dime Bank Bldg.

ELMES



From Photo Taken 1862 of Elmes Employees

60 years of successful business means responsibility and experience building

HYDRAULIC MACHINERY

Charles F. Elmes Engineering Works
222 North Morgan St. Chicago, U. S. A.

Seven Sizes

From 15
Inches
Single
Geared
to 26
Inches
Back
Geared

BEFORE BUYING A CRANK SHAPER

Send for our catalog and compare the specifications of the

KELLY CRANK SHAPER

with any other crank shaper on the market. We invite this comparison because we are confident that, next to a tryout, it is the best way to demonstrate the superiority of the Kelly Crank Shaper.

Kelly Shapers are built strictly as per specifications.

R. A. KELLY CO.
XENIA, OHIO, U. S. A.

HANNA
RIVETERS, SAND SIFTERS, LUBRICATORS

MUMFORD
SQUEEZERS, JOLT RAMMERS, VIBRATORS

QMS
METAL SAWS, HOISTS, CRANES, HAMMERS

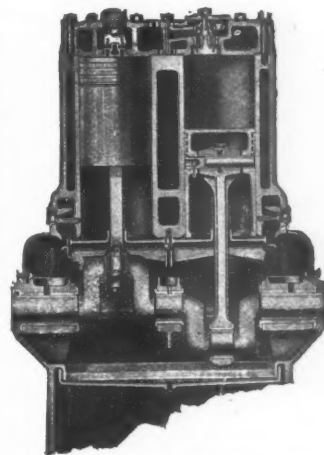
VULCAN ENGINEERING SALES COMPANY

General Agent
1763 ELSTON AVENUE CHICAGO, U. S. A.

The Curtis Compressor

Efficient Cooling Few Parts
Light Disk Valves, Small Clearances

No stuffing boxes, shoes, slides or guides, less friction and wear, lower maintenance. Will run 10 to 15 times as long with the same amount of oil as competing makes, yet will lubricate all parts properly and keep oil out of the discharge line.



Full Self-Oiling
Controlled Splash
Regulatable, Sight
Feed Cylinder Oiling

Write for descriptive bulletin C-1

Curtis Pneumatic Machinery Co.
1568 Kienlen Ave. St. Louis, Mo.

530 G Hudson Terminal, New York City

Oxy-Acetylene Welding and Cutting



Conserve Iron and Steel —Cut Out the Scrap Pile

In ordinary times scrap pile waste costs American business millions of dollars annually. Today, conservation is a matter of national necessity. It is imperative that you help to stop this waste.

Analyze your scrap pile. You'll probably find conditions such as our research men are finding in many industries.

In mine scrap piles were found a year's supply of valuable tram buckets, month's supply of tungsten steel tools, stamp stems and other materials—all easily made good as new at trifling cost by oxy-acetylene welding.

One railway shop saved the tie-up of a hundred locomotives by welding boiler tubes taken from the scrap pile.

There are thousands of other instances where oxy-acetylene welding has made wonderful savings from discarded parts and materials.

As a production process in manufacturing war munitions, railway supplies, boilers, ships, agricultural implements, surgical instruments, etc., oxy-acetylene welding is saving time and materials—giving increased strength, simplicity and neatness to the product.

Prest-O-Lite PROCESS

Employs both gases (acetylene and oxygen) in portable cylinders. Prest-O-Lite Dissolved Acetylene (ready-made carbide gas) is backed by Prest-O-Lite Service, which insures prompt exchange of full cylinders for empty ones. Provides dry, purified gas, insuring better welds, quicker work, and lower cost, and also avoids the large initial outlay and heavy depreciation incurred in making crude acetylene in a carbide generator.

Necessary equipment is not expensive. We furnish high-grade welding apparatus for \$75 (Canada \$100); acetylene service at additional cost. Adaptable for oxy-acetylene cutting by the addition of special cutting blow pipe. Thorough instructions are furnished free to every user of Prest-O-Lite Dissolved Acetylene—any average workman who understands metals can learn the process quickly and easily.

Let us help you analyze YOUR scrap pile. Hundreds of possible savings are described in our illustrated literature—many of them directly applicable to your problems.

Write for it today.

The Prest-O-Lite Co., Inc.

U. S. Main Office & Factory, 837 Speedway, Indianapolis
Canadian General Office, Dept. A.6, Toronto, Ont.

59 Branches and Charging Plants

World's Largest Makers of Dissolved Acetylene



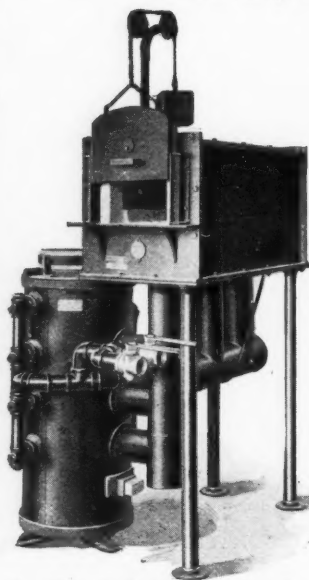
Bellevue Industrial Furnace Co. Detroit, Michigan

Manufacturers of

STEEL TREATING FURNACES

FOR ALL PURPOSES

*Users Assured
High Quality
with Large
Production.*

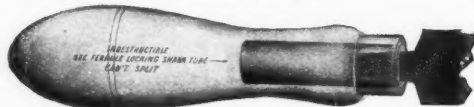


No. 1014—Combination High Speed with Preheating Furnace High Speed. Chamber, 36" deep, 7" diameter. Preheating Oven 11" wide, 36" deep, 10" high, heating from the exhaust of High Speed Furnace.

JULIUS C. HINZ, President

REPRESENTATIVES: Cleveland Tool & Supply Co., Cleveland, Ohio; Coghlin Machinery & Supply Co., Toledo, Ohio; Vonnegut Machinery Co., Indianapolis, Ind.; The Chas. A. Strelinger Co., Detroit, Mich.; Somers, Fittler & Todd Co., Pittsburgh, Pa.; Carpenter & Woodward, 233 Broadway, New York City, N. Y.; The E. A. Kinsey Co., Cincinnati, Ohio.

Years of Service will Wear — But No Strain will Break an Osgood Tool Handle



A steel tube, inserted where the pressure comes, resists all strain and in addition securely locks the tool and ferrule.

*Sample FREE to Dealers and Manufacturers.
To Others Ten Cents.*

J. L. OSGOOD TOOL COMPANY

43-45 Pearl Street

Buffalo, N. Y.

PHOENIX DIE CASTINGS



Finished Die Castings of high quality, good workmanship and perfectly compounded alloys. Let us send booklet and more details.

PHOENIX DIE CASTING CO.

21 Illinois Street
BUFFALO, NEW YORK

LEIMAN BROS. (Note the Name) Carefully

BLOWERS

AND VACUUM PUMPS

This Picture Shows 7 of the 9 sizes

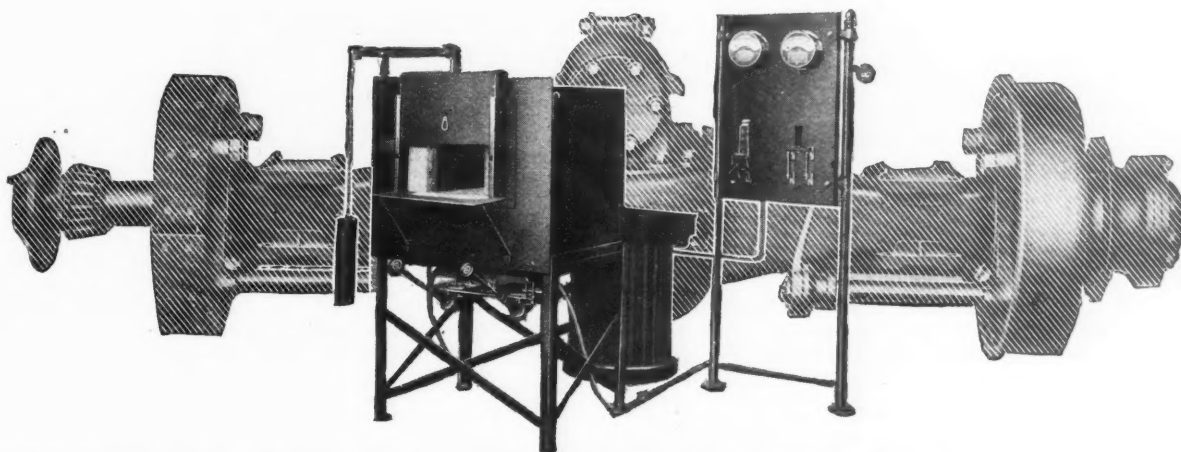


2 to 338 cubic feet per minute. 1 oz. to 10 lbs. pressure. 1 to 20 inches Vacuum, and when desired still higher Vacuum. GET MORE HEAT OUT OF YOUR GAS or OIL FURNACE Get better service from your Vacuum Cleaner, Sandblast or AUTOMATIC MACHINE using Air.

GET CATALOG **LEIMAN BROS., 62 E. John St., New York** WORKS: NEWARK, N. J.



"The Control of Quality"



HOSKINS
TRADE MARK REGISTERED

**Electric
Furnaces**

The leaders in the field control tool quality with Hoskins Furnaces—as does Timken.

Temperature
Control

Lower
Tool Cost

Atmospheric
Control

Hoskins Manufacturing Company
459 Lawton Avenue DETROIT

New York: Grand Central Terminal

Chicago: Otis Bldg.

Pittsburgh: Oliver Bldg.

Boston: Tremont Bldg.

APEX SUPERIOR

HIGH SPEED STEEL



APEX STEEL CORPORATION

50 CHURCH ST. NEW YORK
CLEVELAND OFFICE, 5651 BROADWAY

IN
ALL
SIZES

DELIVERY
FROM STOCK

Highest Quality Ferro Tungsten

Do You Analyze Your Ferro-Tungsten? 
If Not, It Would Pay You To Do So—

The value of a product is largely controlled by the purity of the materials of which it is made.

We Guarantee —

Our Ferro-Tungsten to this analysis:

Tungsten.....	70 to 80%
Carbon—not over.....	1/2%
Sulphur—not over.....	.05%
Phosphorus—not over.....	.08%

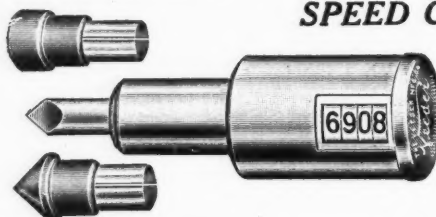
Our facilities are of the very best due to a strictly modern plant and equipment. We are able to offer quick deliveries. Write, Wire or Cable for prices.

THE VANADIUM-ALLOYS STEEL CO.
LATROBE, PENNA.

Makers of "Red Cut Superior"—A Quality High Speed Steel

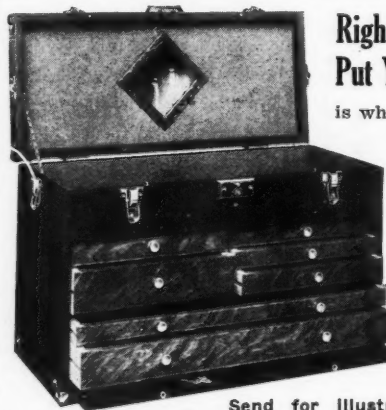
Capacity speeds may be overreached — or full productive capacity *never* reached — unless you take count of revolutions-per-minute.

Veeder
SPEED COUNTERS



report speeds to a turn. Can be started or stopped at just the right moment by means of clutch which engages mechanism. Price, with two rubber tips, \$3.00. Circular gladly sent.

THE VEEDER MANUFACTURING CO.
39 SARGEANT STREET HARTFORD, CONN.
Makers of Cyclometers, Odometers, Tachometers, Tachodometers, Counters and Die Castings



**Right Where You Can
Put Your Hand on Them**

is where your tools should be

H. Gerstner & Sons

make tool cases with a place for everything. Tool cases that are not only convenient, but compact, strongly built and nicely finished. Shipped direct from factory; price reasonable.

Send for illustrated catalog.

H. GERSTNER & SONS 61-71 Columbia Street
DAYTON OHIO

Nothing to Do but Drive

You are not put to the trouble of filing and fitting when you use our Finished Machine Key. We finish them *complete*—all ready to drive,

and you can always depend upon accurate machining and true size. We have special facilities for making Machine Keys any length, width, depth, style or taper. If your keys are costing too much—get our prices.

Our specialties include: Machine Racks, Cold Drawn Shafting, Screw Stock, Flats, Squares, Hexagons and Special Shapes. Send for interesting Catalog.

STANDARD GAUGE STEEL COMPANY, Beaver Falls, Pa., U. S. A.

BRANCH OFFICES: Chicago, Ill., and Philadelphia, Pa. Pacific Tool and Supply Co., San Francisco, Cal. Dilworth Lockwood & Co., New York. R. B. Ridgley, Detroit, Mich. A. L. Maeder Co., Portland, Ore. Hall & Pickles, 64 Port St., Manchester, England.



KLEEN KUT

A 100 per cent perfect water soluble—designed especially for the consumer who appreciates the highest standard of quality at a minimum cost.

Each of our products is backed by a reputation of 50 years in business.



Our business was founded on quality—developed on quality—and we will continue to feature quality.

DASCOLENE

A scientifically treated lard oil. A base oil of quality equal to No. 1 lard oil. May be reduced with mineral oils for any machining operation. We will be glad to quote you or ship a barrel for test.

Write for our book "Kleen Kut Facts"—This is a treatise on machine tool lubrication.

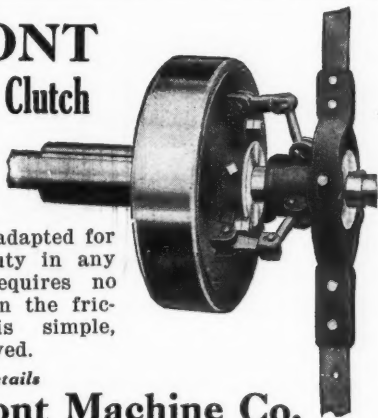
D. A. STUART & CO., Inc.
29 So. La Salle St. CHICAGO, ILLINOIS
FACTORY: 350-360 E. ILLINOIS STREET

EDGEMONT Extended Sleeve Clutch

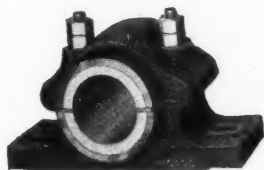
Designed to drive wood or steel pulleys, gears, drums, rope sheaves, sprocket wheels, etc., and adapted for continuous, heavy duty in any surroundings. It requires no oiling or attention on the friction mechanism; is simple, powerful and long-lived.

Catalog E for Details

The Edgemont Machine Co.
2700 National Avenue DAYTON, OHIO, U. S. A.



Power Transmitting Machinery



Heavy Pillow Block

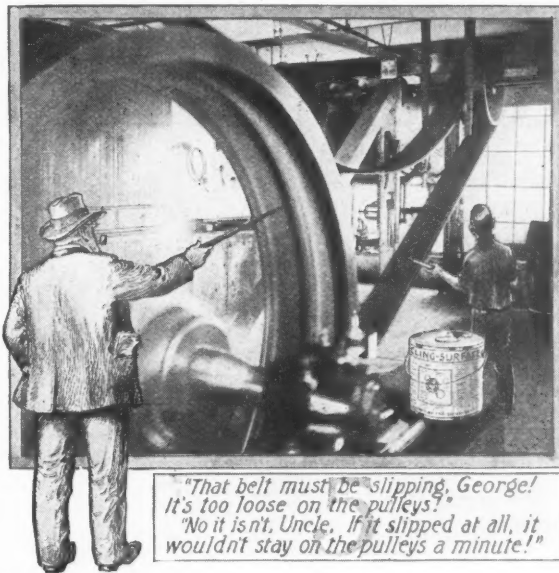
Heavy bearings, drop hangers and post hangers.

Machine moulded gears and pulleys.

Friction clutches, rope drives and chain drives.

H. W. CALDWELL & SON CO.

Elevating, Conveying and Power Transmitting Machinery
17th Street & Western Avenue, Chicago, Ill.
50 Church St., New York. 709 Main St., Dallas, Texas.



THE new Superintendent was different. For the first few days he just walked through the plant and looked at things. Down in the engine room he took the speed of the engine. Up in the shop he took the speed of the main shaft. Then he did some figuring. These are the figures.

Driving pulley 8 feet diameter.
Speed 80 rev. per minute.
Driven pulley 4 feet diameter.
Speed should be 160 rev. per minute.
Speed actually 155 rev. per minute.

Loss 5 rev. per minute.

$5 \div 160 = 3\%$ approximately.

8 feet \times 3.1416 \times 80 rev. per minute = about 2000 feet per minute the belt travels.

3% of 2000 feet = 60 feet per minute LOST.

Pulley centers at 20 feet, so belt length approx. 60 feet.

This meant that once every minute his belt was useless, for the loss in feet per minute due to slipping was more than the length of the belt itself!

In a ten-hour day this loss would be 36,000 feet, so that every day the engine had to give that belt a free ride of nearly 7 miles! And the firm paid the bills at the coal pile and machines, at the bearings, pulleys and in the belt itself. It didn't look right.

The plant had over one hundred belts. If they all slipped, the firm must be losing hundreds of dollars a year in power, time and equipment which might better be saved.

The new Superintendent never did things on impulse, or merely on someone else's say-so. Back in his experience he had used CLING-SURFACE, the treatment which PREVENTS SLIPPING, and allows the usual drive to be run easy or slack under full load. He knew that it makes constant tension unnecessary, preserves and makes the belts thoroughly pliable and waterproof; that it is not sticky, contains no rosin or anything harmful, and is safe, easy and economical to use.

So he had every belt treated, and the effect was seen at once. His slipping stopped, he had more and steadier power, and not a belt has been taken up since that time.

This is fact; we can prove it on your drives to YOUR satisfaction. Just ask for THE PLAN 10,000 firms have found successful.

And remember, use CLING-SURFACE and you won't need belt dressings.



Cling-Surface Company
1018 Niagara St Buffalo NY

New York Chicago Memphis Denver
Boston St Louis Atlanta Toronto Etc

Copyright 1917 by Cling-Surface Co

There Are Two Different Kinds of Genuine Graphited Oil-Less Bushings

NIGRUM

(Impregnated Hard Wood) Oil-Less Bushings are made of selected hard wood, thoroughly seasoned and then thoroughly impregnated with our special lubricating compound.

This bushing not only runs efficiently and lasts indefinitely without oiling or any attention whatever, but it is light in weight, small in bulk and has the additional advantage of absorbing grit and dust without harm to itself, thus prolonging its own service life as well as that of the shafting.

Oiling will not hurt these troubleless bushings, but they will give efficient service even if overlooked, and as the life of a machine is no longer than the life of its bushings, the proper installation of BOUND BROOK Bushings gives assurance of long life and increased efficiency.

LEADING MANUFACTURERS throughout the country, as well as the U. S. and foreign governments, have endorsed these bushings by using them in hundreds of different kinds

We should be glad to advise with you concerning your own particular bushing problems

All Genuine Graphited Oil-Less Bushings Have Always Been Made at Bound Brook, U. S. A.



BOUND BROOK

(Graphite-and-Bronze) Oil-Less Bushings are made of finest phosphor bearing bronze, so constructed as to retain a sufficient quantity of our specially prepared lubricating graphite to keep them lubricated in service, even if neglected.

They are used as an insurance against neglect of machine parts that are inaccessible and therefore difficult or impossible to keep properly lubricated.

of machinery, from Armored Cars, Battleplanes and Naval Vessels to Mill and Factory Machinery, Windmills, Escalators, Gas Engines, Elevators, Mining Machinery, etc., etc.

TEN MILLION BUSHINGS per annum is the capacity of our plants at Bound Brook and Lincoln, New Jersey, where we have every facility for the manufacture of highest quality bushings in large quantities on short notice. Prompt, dependable deliveries are, therefore, assured.

BOUND BROOK OIL-LESS BEARING CO.

Specialists in the manufacture of Oil-Less Bushings for more than a Third of a Century

BOUND BROOK

NEW JERSEY

No Power Swallowed Up In CHAPMAN BEARINGS

Every bit of power is directly available for the work, in shops where Chapman Bearings are used on shaft transmission. When we add that the *average* saving of power

reported is 20 per cent, you can get an idea how much your friction loss is—aside from the waste of time and oil for upkeep, eliminated along with the friction, if you are not using

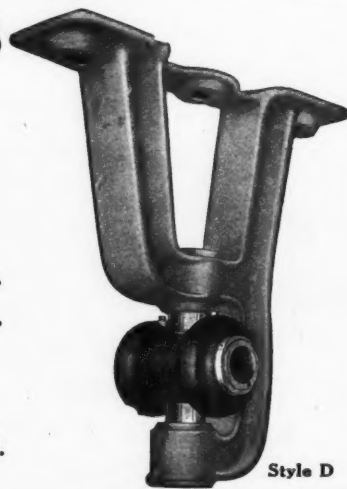
CHAPMAN BEARINGS

We suggest that you write for our Bulletin No. 106, which explains the why and wherefore of Chapman saving.

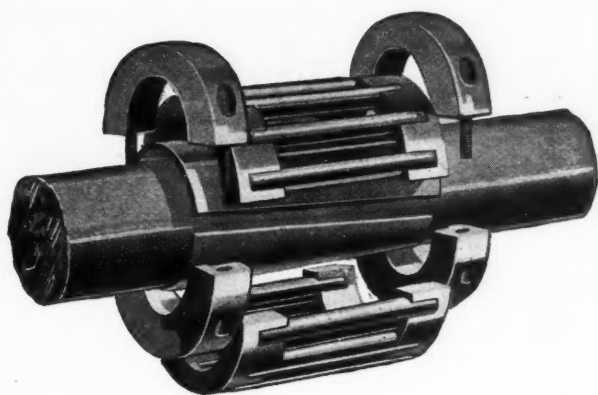
**TRANSMISSION
BALL BEARING CO., Inc.**
1050 Military Road Buffalo, N. Y.

BRANCH OFFICES

NEW YORK, Room 101, 30 Church Street
PHILADELPHIA, Bourse Building
TORONTO, ONT., Chapman Double Bearing Co., Ltd.
339-351 Sorauren Avenue



Style D



A letter is interesting to the extent that it either says something worth while or reflects personality—the personality of the writer.

A piece of machinery is serviceable to the extent to which it does something well—and is the embodiment of the character of the maker.

Conscientious workmanship and sound materials, as well as a regard for performance, efficiency and upkeep, are reflected in "Sells" Roller Bearings.

Take one point at a time—say the rollers. There is a lot of good judgment in the selection of rollers instead of balls. The greater bearing surface of the rollers will reduce the friction, lessen the amount of attention and lubrication required, and greatly decrease the wear on the shafting. Ball bearings wear grooves in the retainers, rollers do not, but as a further protection against wear in Sells Roller Bearings, there is a hard metal sleeve to protect the shaft.

These are the simple devices that help reduce the friction from 25 to 50 per cent over ordinary bearings. Just look at the picture. Did you ever see a better combination of common sense and mechanical simplicity?

Call me up or write to me and I'll explain the "Sells" principles as fully as you wish.

Yours for less friction,

John D. Sells
Manager.

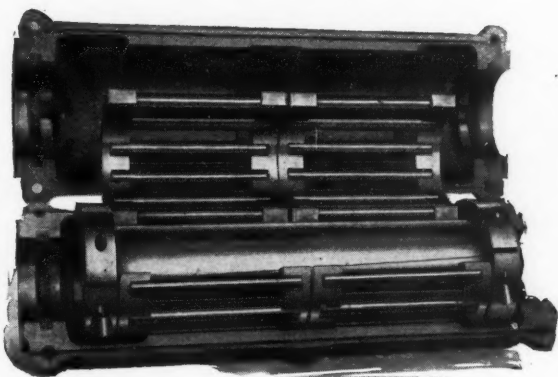
Royersford Foundry & Machine Co.

54 North Fifth Street

Philadelphia, Pa.

"Sells" Line Shaft Bearings, "Sells" Commercial Roller Bearings, Babbitted Ring Oil Bearings, Shaft Hangers, Collars and Couplings, Punches and Dies, Punching and Shearing Machines, Sensitive Drill Presses, Foot Presses, Grinding and Polishing Machines, Tumbling Barrels, "Rollerine"—the ball and roller bearing lubricant.

Old Reliable "Sells"



"NORMA" BALL BEARINGS

(Patented)

Bearing failure means machine failure. Resultant losses lie not alone in the cost of repairs, but in the interrupted service, the loss of output—and the loss of your prestige as a manufacturer of a dependable machine. Can you afford to risk these losses by using any but bearings of proved reliability?



We will welcome an opportunity to explain to you the factors which lie at the root of "NORMA" dependability—the open type and separable construction—the rigid mounting of both races—the unequaled precision—the silent-running, vibrationless qualities. We can probably help you to better bearing service, higher bearing serviceability. Then—

*Let it be said of your machine,
"It is 'NORMA' equipped."*

THE NORMA COMPANY OF AMERICA

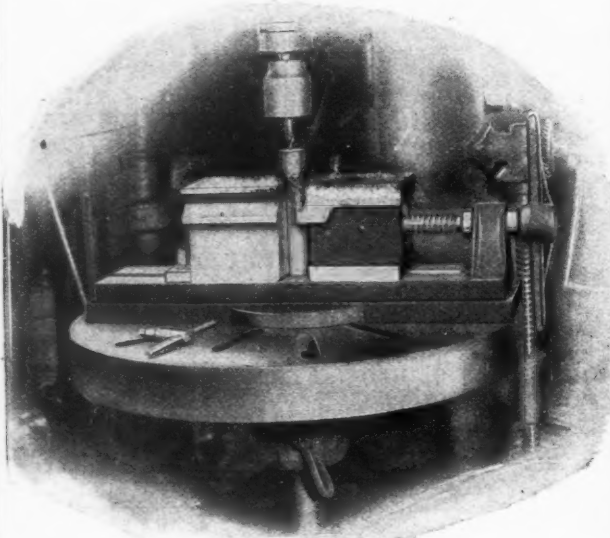
1790 BROADWAY

NEW YORK

Ball, Roller, Thrust, Combination Bearings

SAVE

Those 30 Minutes That Your
Men Waste Daily In
Setting Up Work



WITH THE UTILITY TIME SAVING VISE

On any machine with a horizontal table, such as a drill press, miller or shaper, this vise clamps instantly work of any shape, and in any position desired. No parallel strips, V-blocks, clamps or other similar pieces are needed. The revolving four-sided rear jaw adapts itself to any form or position of set-up, vertical, horizontal or at odd angles. Irregular shapes are gripped with the same speed by means of auxiliary jaws.

That's why the Utility TIME-**SAVING** Vise will save all the time your machinists waste in hunting for, and adjusting the many clamps and fixtures ordinarily required for setting up—why it will get 30 to 60 more minutes of *production* out of those men and their machines every working day.

On the machine that must handle a variety of work, the Utility TIME-**SAVING** Vise will pay back its cost in a few weeks. You can prove that fact in your own shop at our expense. The coupon will bring full details of our **FREE TRIAL OFFER**. Clip and mail the coupon—now.

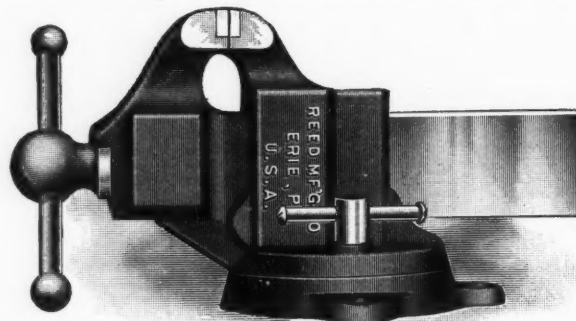


Aug., 1917.

THE BROWN ENGINEERING CO.,
133 N. Third St., Reading, Pa.

Send me details of your Utility TIME-**SAVING** Vise with full information concerning your **FREE TRIAL OFFER**.

Name
Position
Firm
Address



Choosing A Vise

Here are some practical hints valuable to vise purchasers. Get one size larger vise than would ordinarily be required for the work, as the larger vise will not spring away from a blow heavy enough to work the material.

REED VISES

should invariably be chosen, as they have a "limit gage" accuracy, are machine finished and have wide bearing surfaces offering greater wearing resistance.

When buying vises use our Catalogue H as a reference book.

Reed Manufacturing Co.
ERIE, PENNSYLVANIA, U. S. A.

W & B TOOL Cases Prolong TOOL Life

Tool life is short at best—good care prolongs it. We have done our bit for your tools in providing a good case at a reasonable figure.

Write for catalog
today

WEDELL & BOERS
157 Jefferson Ave.
Detroit, Michigan



TAPS AND REAMERS

First-class Tools and Prompt Deliveries

REIFF & NESTOR, Lykens, Pa.

Quick Operating Lever Vise

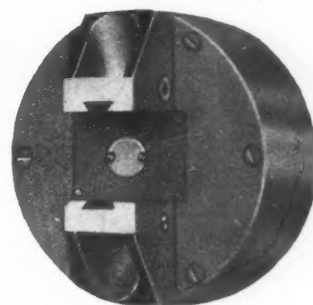
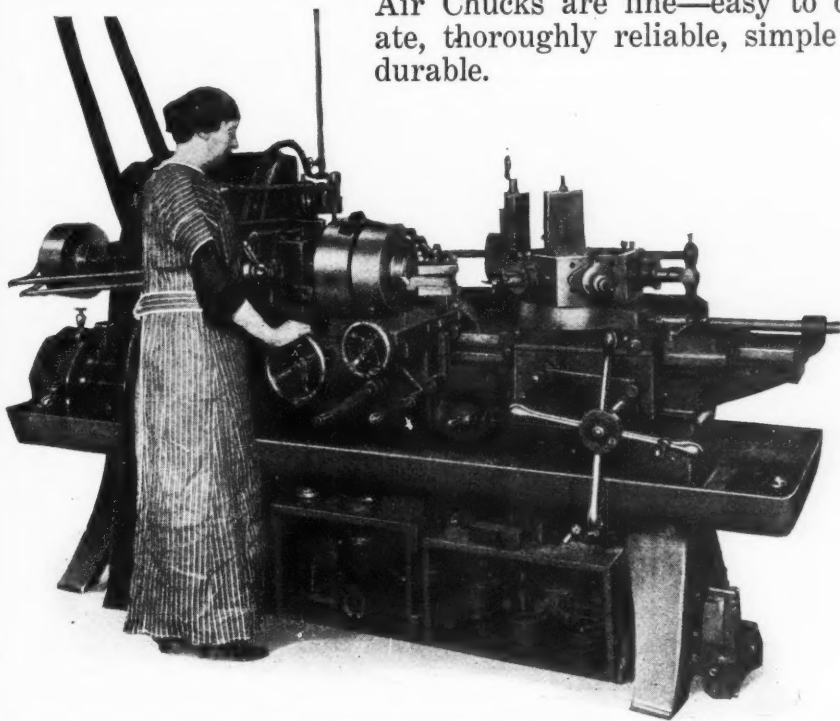
This Vise is well adapted for use where operation of milling or drilling is short and a large number of pieces are to be handled quickly.

Send for Circular.
The Carter & Hakes Company
Sterling Pl., Winsted, Ct.



AIR CHUCKS? FINE!

This operator enthusiastically reports a 25 per cent increase in production since she has had the "Hannifin." Other reports vary from 20 to 100 per cent, but all agree that Hannifin Air Chucks are fine—easy to operate, thoroughly reliable, simple and durable.



The best test is a tryout.
Send for one on trial.

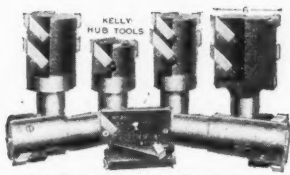
HANNIFIN MFG. COMPANY

CHICAGO U. S. A.

REPRESENTATIVES

R. E. Ellis Engineering Co.,
Chicago.
Naumann-Firmin Co.,
602 Kerr Bldg., Detroit, Mich.
Coats Machine Tool Co.,
New York City.
A. R. Williams Machinery Co.,
Toronto.
Williams & Wilson,
Montreal.
Canadian Fairbanks-Morse Co.,
Montreal, Que.
EUROPEAN REPRESENTATIVES
Coats Machine Tool Co., Ltd.,
London.
Fenwick Freres & Co.,
Paris.
Iznoskoff & Co.,
Petrograd.

KELLY PRODUCTION TOOLS



FOR
CYLINDERS,
CRANKCASES,
CONNECTING
RODS, AUTO
PARTS, ETC.

They
"ADJUST"

We make DELIVERIES in 1 to 10 days
Write for the catalog G-3

THE KELLY REAMER CO.

CLEVELAND, OHIO, U. S. A.
Burton, Griffiths & Co., Ltd., London, English Agents
Burton Fils, Paris, French Agents 40 Domestic Agencies

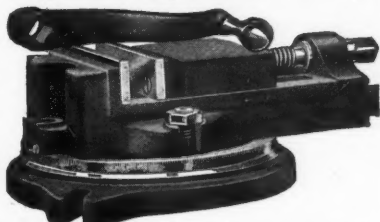


KELLY
"Multiple"
7
Operations

TRADE **PRODUCTION** MARK

Swivel Milling Vise (Graduated)

Width of Jaw...5 in.
Depth of Jaw...1 3/8 in.
Vise opens.....3 in.
Weight.....45 lbs.



\$22.00

NEW JERSEY MACHINERY EXCHANGE
NEWARK, N. J.

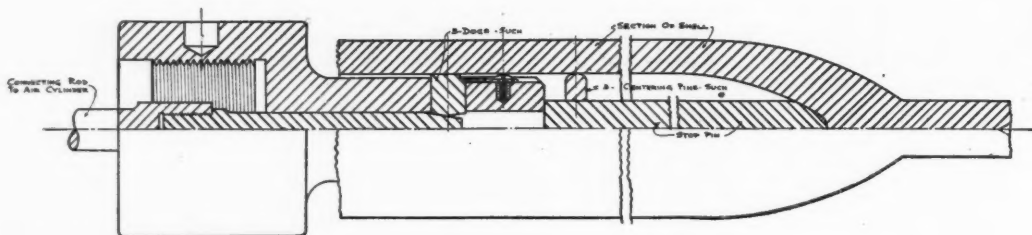
Save Your Taps with the "WEAR-EVER" TAP CHUCK



With the
Wear-Ever
Tap Chuck
the tap runs
true and break-
age is reduced to
a minimum. Use it
like a socket and stick
it in the spindle like a
drill. It takes but a mo-
ment to change taps—no expert requir-
ed, no screws to adjust, no setting for
various size taps—just a single piece of
metal, hardened, but it will outwear
any number of friction taps and—the
price is low. Try it and prove it.

SCULLY-JONES & CO.

647 Railway Exchange Bldg. Chicago, Ill.



AMERICAN SHELLS

ARE NOW BEING MADE BY

M. E. C. Short Expanding Mandrels

AIR-OPERATED

Shown in Illustration

Manufacturers Equipment Co.

175-179 N. Jefferson St., Chicago, U. S. A.

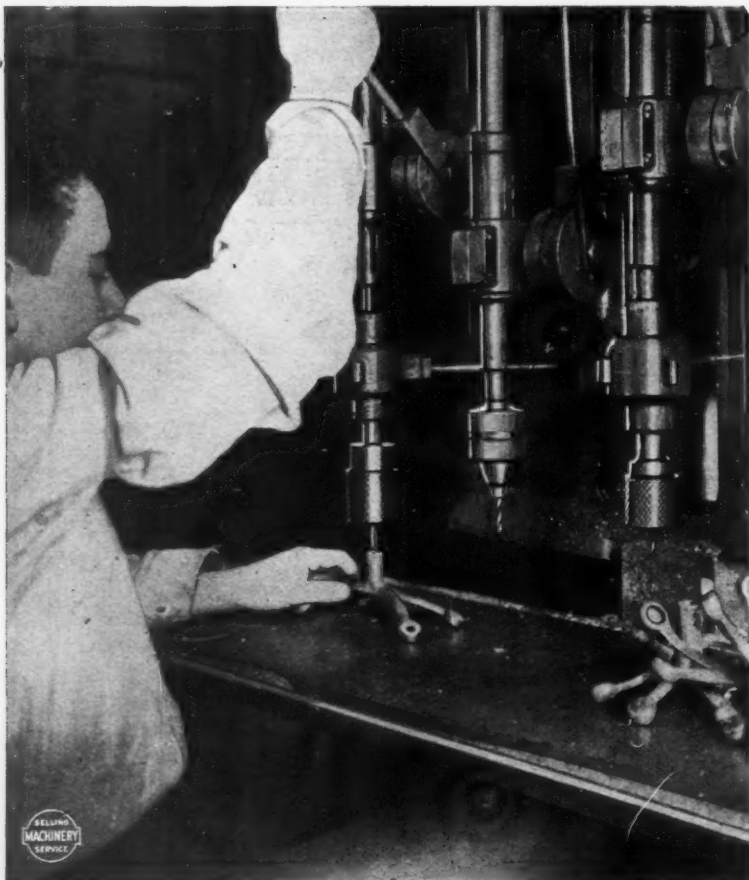
AGENT FOR CENTRAL AND EASTERN STATES AND CANADA:
J. R. Stone Tool & Supply Co., Goebel Bldg., Detroit, Mich.

FOREIGN AGENTS: Burton, Griffiths & Co., Ltd., Ludgate, Ludgate,
Square, London, England.

Hundreds of makers of American shells have found M.E.C. Mandrels reliable, durable and efficient. They are particularly adapted for rough and finish turning. Compensating mandrel furnished for cutting rough shell forgings to length and for centering.

In the past three years M.E.C. Chucks and Mandrels have been extensively and profitably used not only in munition work, but in automobile and gas engine manufacturing as well.

If you are in the market for labor-saving devices of this kind, by all means get in touch with us. Tell us your problems. We know we can help you. Write today for our latest catalog describing M.E.C. Labor Saving Devices.



Again the Woodstock Tapping Chuck "Brings Home the Bacon"

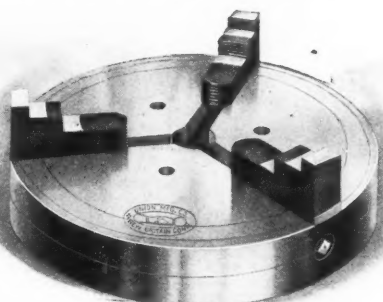
The Philadelphia Scoop Co. never knew trouble-proof tapping until they tried the "Woodstock." Now any tapping job is plain sailing, with broken taps as scarce as they formerly were numerous. Tapping scale pans is the job, the operator using a $\frac{1}{4}$ inch and a $\frac{3}{8}$ inch chuck for the work. The "Woodstock" is a fixture in this plant because of its speed, accuracy and economy—and we could tell you of hundreds of other shops where this same experience applies. The shop that uses the Woodstock Tapping Chuck knows tapping satisfaction. Why not yours?

Try one for 30 days free and see what it can do.

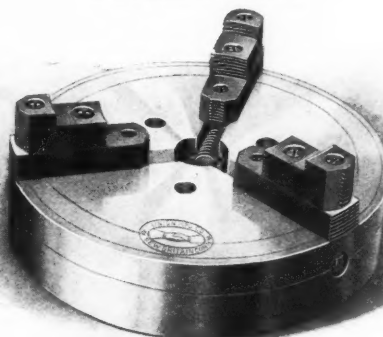
PETER BROTHERS MFG. CO., 135 Railroad Ave., Algonquin, Ill.

UNION

Makers of a Complete Line of Chucks



OUTSIDE JAWS



REVERSIBLE JAWS

Combination Lathe Chucks

PINION SCREW TYPE

UNIVERSAL
INDEPENDENT
ECCENTRIC
CONCENTRIC

The Union Combination Chuck as illustrated is made with solid or reversible jaws, also with four jaws. This type (Pinion Screw) of chuck makes a very accurate and quick acting chuck. Especially adapted for tool room, fine manufacturing, or experimental work.

UNION MANUFACTURING CO.

NEW BRITAIN CONN., U. S. A.

NEW YORK OFFICE: 26 CORTLANDT STREET

ROGERS TOOLS



Reamers
Measuring Standards
Adjustable Hollow Mills
Mandrels, Etc.

The John M. Rogers Works, Inc.
Gloucester City, N. J., U. S. A. 1865-1917

Skinner Independent Chuck

Iron Body
(Figure 900)

Steel Body
(Figure 1900)

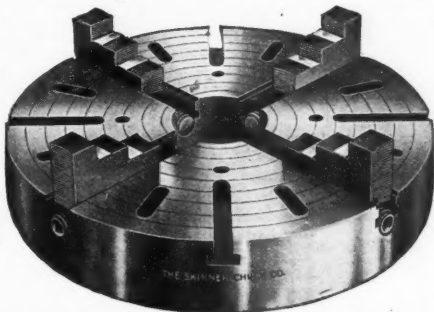
The most popular chuck on the market.

Contains all the latest improvements.

Want Catalog?

THE SKINNER CHUCK COMPANY

Factory and Main Office: NEW BRITAIN, CONN.
San Francisco Office: Rialto Building. New York Office: 94 Reade St.
London Office: 149 Queen Victoria St.



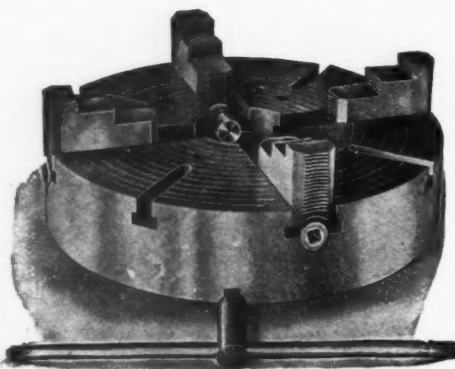
For Rapid Grinding Use "D & W" Magnetic Chucks

In fact, for planing, shaping and milling as well; the "D & W" Magnetic Chuck lends itself most profitably to a wide range of uses. No clamping or bolting—place the work in position, throw on the switch and go ahead. When the job is finished, another turn of the switch releases the work.

Ask for Bulletin 10-M

D & W FUSE COMPANY
PROVIDENCE, R. I.

THE RIGHT CHUCK FOR HEAVY TURNING



This Horton All-Steel Heavy Duty Chuck, made with extra large screw, double thrust bearings and long, wide jaws, possesses strength, power and endurance equal to the heaviest demands. In its thoroughness of construction it's a typical example of Horton standards and a true representative of a specialized line that provides a chuck for *every* purpose. Use Hortons in your plant and you'll be sure of chuck service par excellence.

Catalog lists entire line.

THE E. HORTON & SON CO.
WINDSOR LOCKS CONNECTICUT



Makers of the Tool with the Tool-Steel Bearing

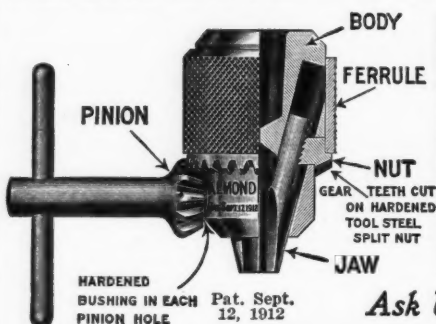


The Chuck That
Never Slips.

The More
You Crowd it,
The Tighter
It Grips.

NARRAGANSETT MACHINE CO.
PROVIDENCE, R. I., U. S. A.

ALMOND CHUCKS



POWERFUL
ACCURATE
DURABLE

COST LESS
TO
MAINTAIN

Ask Us Why

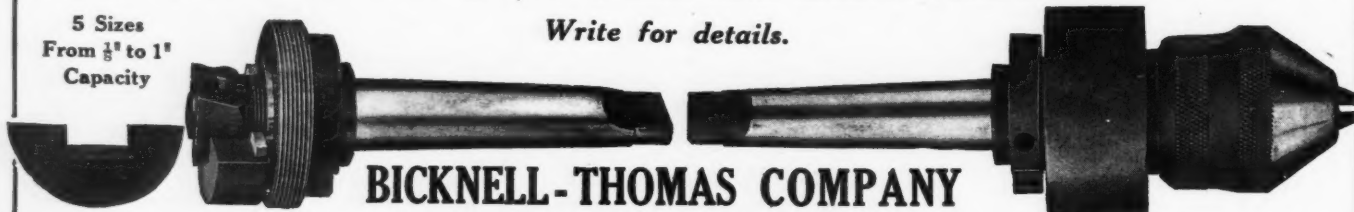
T. R. ALMOND MANUFACTURING CO.
2 MAPLE AVENUE ASHBURNHAM, MASS.
LONDON OFFICE: 8 White Street, Moorfields, London, E. C.

TIME TO LOOSEN UP

A chuck must grip tight, up to the limit of its driving capacity; but when the tool binds or strikes bottom is the time to loosen up. The Bicknell-Thomas Friction Chuck does this automatically—that is why there are no broken taps where Bicknell-Thomas Chucks are used. It is especially adapted for blind tapping and on machines having relatively small center distance between holes.

5 Sizes
From $\frac{1}{8}$ " to 1"
Capacity

Write for details.



BICKNELL-THOMAS COMPANY

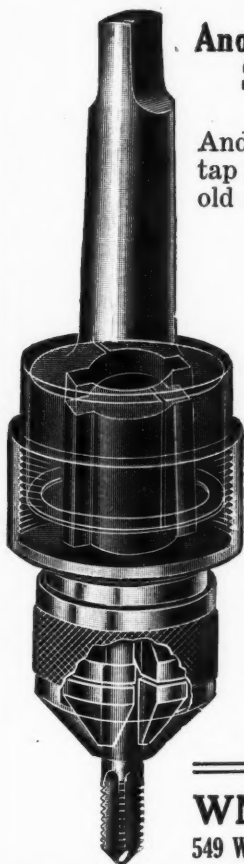
Greenfield, Massachusetts, U. S. A.

PING!

Another
Tap
Broken—
Another Casting
Scrapped



And the operator must get a new tap from the toolroom before the old one is worn out.



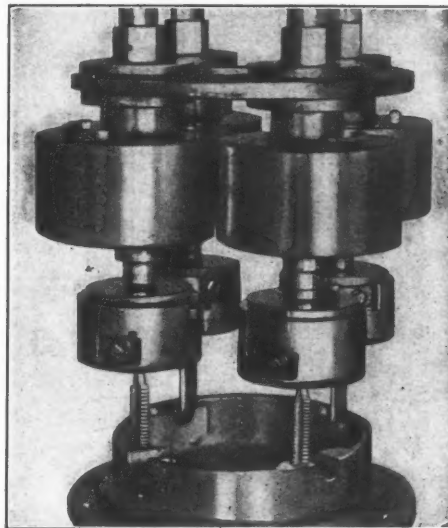
TAKE THE PING
out of TAPPING
with the
"Double-Gripp"
SAFETY
Tapping Chuck

The SAFETY FRICTION does it.
Only the "DOUBLE-GRIPP" has it.

Write for our new circular to-day. It's a yard long and tells all about the Safety Friction and the jaws that made the "Double-Gripp" famous.

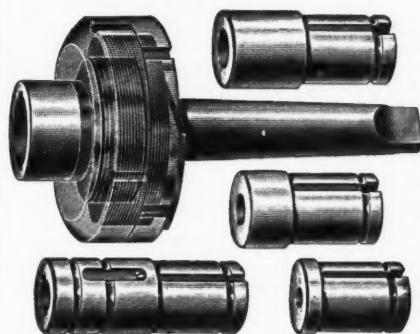
WM. L. PROCUNIER
549 Washington Blvd., CHICAGO, U. S. A.

**ERRINGTON
MECHANICAL
LABORATORY**
39 Cortlandt St., New York
136 West Lake St., Chicago

**MULTIPLE
TAPPERS**

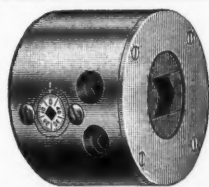
ERRINGTON TAPPERS reduce tapping costs to the minimum, insure exact duplication of work, are simple, compact and long wearing. Taps up to $\frac{5}{8}$ " can be used with only $2\frac{1}{4}$ " between centers, and larger sizes are proportionately compact. In the job shown in the engraving 2560 $\frac{3}{8}$ " holes were drilled and tapped in malleable iron gear cases in eight hours. Let us figure on your line of tapping.

Errington Opening Die Heads; Collapsing Taps; Opening Stud-Setters; Friction Stud, Nut and Screw Setters, etc.

The Safety Drill and Tap Holder

is the only attachment for the purpose that gives universal satisfaction and is unequalled in efficiency, convenience, rapidity, accuracy and simplicity. Nothing to break or get out of order. Made in 4 sizes, covering from 0 to $2\frac{1}{2}$ inches diameter.

The Beaman & Smith Co. PROVIDENCE
Rhode Island

**Flynn Offset Boring Heads**

This chuck, which has a micrometer adjustment and large range, is strong, durable and easily operated.

Write for free circular

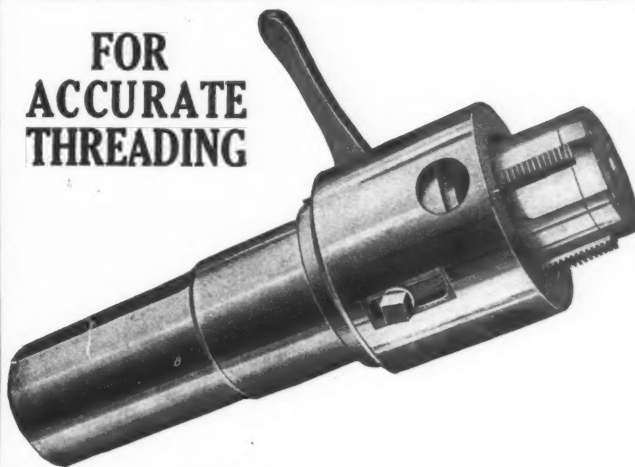
J. M. WATERSTON, 77 Woodward Ave., DETROIT, MICH.

1874 TRUMP DRILL CHUCK 1917

We have been making it for 43 years; it is still the BIG Chuck at the SMALL price; for Straight or Taper Shank Drills.

Three Sizes: No. 1 0 to $\frac{1}{8}$ " No. 2 0 to $\frac{1}{4}$ " No. 3 0 to $\frac{3}{8}$ "

Write for prices and particulars
TRUMP BROS. MACHINE CO. Wilmington, Del.

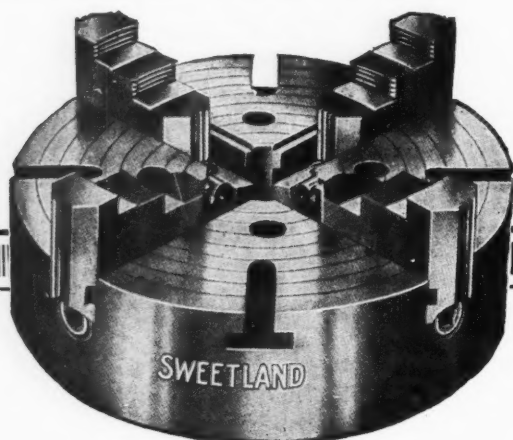
**FOR
ACCURATE
THREADING**

On tapping operations in general, the greatest damper on accurate production is the slow, uncertain backing out of the tap. Use

VICTOR COLLAPSIBLE TAPS

and tapping can be made your most productive operation. Never any spoiled threads, and the work is done in half the time required by solid taps. Victor Taps are adjustable for size and spring tension, will cut large and small threads, and stand the strains of heavy cutting. Sizes from 1 to 12 inches, either straight or tapered shank. Circular?

VICTOR TOOL CO.
WAYNESBORO, PA.



Quick Control of a Giant Grip

Experienced men readily see that only the combination of these two things—easy control and strong grip—can bring chucking to a maximum point of profit. An immovable grip to assure accuracy; quick control to utilize the operator's time.

SWEETLAND Lathe Chucks

hold work against all the power that any machine can deliver, and avoid the fractures, distortion and other inaccuracies that lead to the scrap pile.

With this gripping power easily exerted and controlled—with the quick and ready adaptability to work of differing shapes and requirements, Sweetland Chucks are a means of satisfactory chucking that shows on the profit sheets.

The special features that bring about these and other individual advantages are shown in detail in the booklet, "Chucking for Profit." Ask for it.

HOGGSON & PETTIS MFG. CO.
NEW HAVEN CONNECTICUT

Drill Chucks Lathe Chucks Centering Chucks Portable Face Plate Jaws

Steel Bodies
Iron Bodies

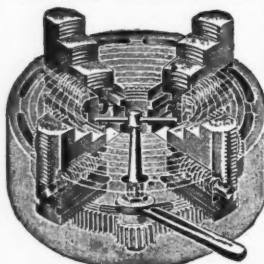
Many Styles and Sizes.
All Designed for Hard
and Exacting Service.

==== *Catalog Free* =====

THE CUSHMAN CHUCK CO.
HARTFORD CONN., U. S. A.

If You want the best Lathe or Drill Chucks—buy Westcott's

Little Giant Auxiliary Screw Drill Chucks, Little Giant Double Grip Drill Chucks, Little Giant Improved Drill Chucks, Oneida Drill Chucks, Spur Geared Scroll Combination Lathe Chucks, Scroll Combination Lathe Chucks, Spur Geared Scroll Universal Lathe Chucks, IXL Independent Lathe Chucks, Cutting-off Chucks.



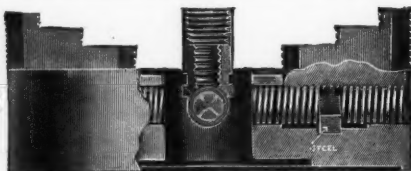
Spur Geared Scroll Combination
Lathe Chuck

Strongest Grip, Greatest Capacity
Great Durability and Accuracy

WESTCOTT CHUCK CO.
ONEIDA, N. Y., U. S. A.

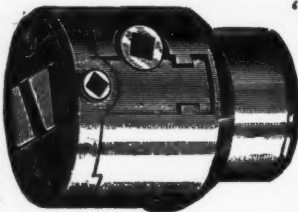
Ask for catalogue

Solid Steel Rings Reinforce these Independent Lathe Chucks



making them strong where other chucks are weak, providing for tensile stresses and screw thrusts, insuring greater durability and better service.

"National" Round Body Drill Chuck



Made with three distinct grips which can be applied at the same time when necessary—a positive gripping chuck—all sizes up to 2 inches. *Catalog?*

Oneida National Chuck Co.
ONEIDA N. Y., U. S. A.

JACOBS



FIVE SIZES

- No. 1—0 to 13-64"
- No. 2—0 to 21-64"
- No. 3—0 to 17-32"
- No. 4—1-16" to 3-4"
- No. 5—3-8" to 1"

JACOBS—The Chuck

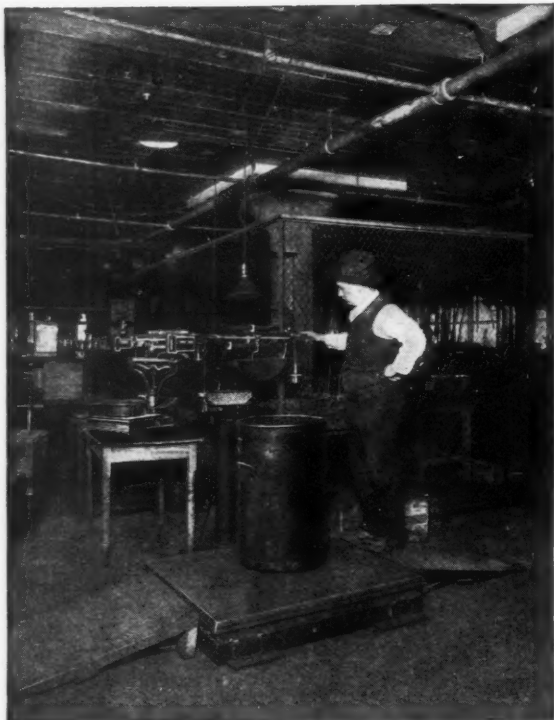
Ever since the Jacobs Improved Drill Chuck was first marketed, in 1902, it has held its place as the leader in this field. Thousands have been sold—all over the world. And this chuck is more popular today—selling in greater numbers—than ever before.

The Jacobs Improved Chuck combines convenience, efficiency, accuracy and durability. What more can you ask?



**The Jacobs
Manufacturing
Company**

Hartford, Conn., U.S.A.



National Counting Machine at the Plant of Stewart-Warner Speedometer Corporation, Chicago, Ill.

Instead of a Handful Count a Thousand

THAT is what it means to have your counting done with a

NATIONAL COUNTING MACHINE

IT gives you a mechanically accurate count—not a brain-wearied result which may or may not be right—usually not.

The human brain cannot compete either in speed or accuracy with the National Counting Machine, because the machine doesn't get tired—the brain does.

The National Counting Machine will handle any kind of like unit raw material or finished stores in 50 to 90 per cent less time than it takes to hand count. On an inventory it often saves days of labor.

Illustrated Catalog MA on Request

National Counting Machine Co.

Distributors for the National Scale Co.

8 Mechanic Street, Chicopee Falls, Mass.

Also Builders of

NATIONAL-CHAPMAN ELEVATING TRUCKS

FOREIGN REPRESENTATIVES

S. Haug Ellingsen & Co., Christiania, Norway. Burton, Griffiths & Co., Ltd., London, England. H. Brenneisen & Co., 5 Jules Ferry Boulevard, Paris, France.



A Progressive Mechanic

has a place for every tool. He knows immediately if any tool is gone, misplaced or borrowed. He should have a

UNION TOOL CHEST

Compact, durable, perfectly designed. Keeps tools clean, safe, free from bangs, knocks and moisture. Saves time because tools can be so arranged that you only need open the drawer and pick out the tool wanted.

Made of plain or quartered oak or leatherette covered. Highly finished. Specially designed drawers, strong and perfectly fitted, some with felt. Drawer pulls—specially designed, practical and efficient. Space saving flush-ring. Every chest guaranteed to give perfect satisfaction to meet with your entire approval or money back.

Write for our Catalog and Prices of Nineteen Styles and Sizes. If there isn't a "Union" Dealer near you, get our Special Offer.

UNION TOOL CHEST WORKS

10 Railroad St., Rochester, N.Y.



Style A

Adjustable
to fit
any face



Can be worn
over other
glasses

For all munition workers

Send for illustrated price list

T. A. WILLSON & CO., INC.

Chicago

Factory and Main Offices, Reading, Pa.

San Francisco

Toronto

London

K & E

Drawing Materials, Mathematical and Surveying Instruments, Measuring Tapes.

Write for Catalogue.

KEUFFEL & ESSER COMPANY

127 Fulton Street

NEW YORK

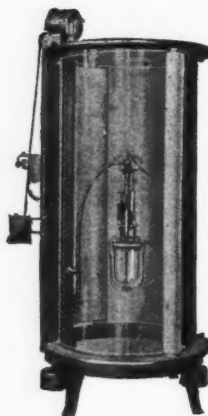
General Office and Factories: HOBOKEN, N.J.

Chicago

St. Louis

San Francisco

Montreal



Electric Blue Printing Machines

Shipped on
30 days' trial

Write for Catalogue B-2

Buckeye Engine Co.
Salem, Ohio

SAFETY GOGGLES

FOR

Chippers Grinders Riveters
Welders Drillers
Babbitters Pourers Boiler Makers
Cupola Workers Open-Hearth Workers

For Eye Protection of All Those who
do Work that Might Cause Eye Injuries.

Write for our catalog.

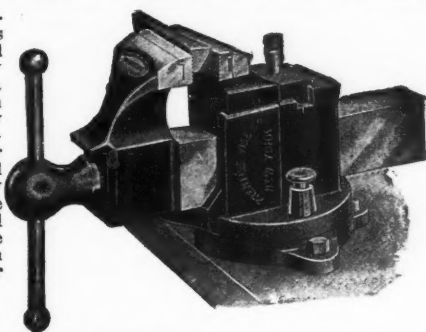
F. A. HARDY & COMPANY

John H. Hardin, Pres.

10 S. Wabash Ave., Chicago, Ill. 15 W. 36th St., New York, N. Y.

Machinists' Swivel Vise

with self-adjusting jaw that is as strong and durable as any solid jaw, and a Swivel Bottom that gives any desired adjustment to right or left, and is solid and firm at any angle. We make all sorts of good vises, and have been leaders in this line for forty years.

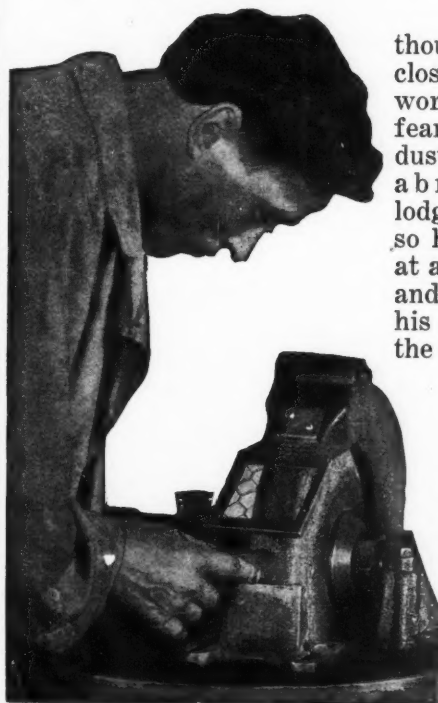


Send for catalogue
and price list.

PRENTISS VISE COMPANY, 106-110 Lafayette St.
NEW YORK

Sole Agents for Canada: A. Macfarlane & Co., Coristine Bldg., Montreal.

This Operator Does Not Squint



though he bends close over his work. He has no fear that flying dust or bits of abrasive will lodge in his eyes, so he keeps them at a normal focus and centers all his attention on the task in hand.

The **UNIVERSAL EYE GUARD** insures this freedom, and it costs his employers only \$2.00—money well invested.

EYE GUARDS { **FOR SHAPERS, \$3.00**
 { **FOR LATHES, \$3.50**

THE SAFETY ENGINEERING COMPANY

1444 Schofield Bldg.

Cleveland, Ohio



\$100 in Prizes!



IN order to illustrate the effective use of the pencil as a medium of expression for engineering and technical work we shall offer \$100 for the best drawings or designs.

First prize \$50

Second prize \$20

Third prize \$10

Fourth to Seventh prizes \$5 each

A special box of **VENUS Drawing Pencils** will be sent to all contestants awarded honorable mention.

CONDITIONS:

1. The drawing submitted must illustrate *pencil* work.
2. Name and degree of whatever pencil is utilized, and name and address of sender must be written on the back of the drawing.
3. All drawings submitted are to become the property of the American Lead Pencil Co. and none will be returned.
4. Contest closes Sept. 10, 1917.
5. *Important*—The drawing must relate to some one of the following branches of engineering: (a) mechanical, (b) electrical, (c) civil, (d) automotive, (e) military, (f) marine or naval.

Mr. H. E. Cleland, Manager of the Service Department of the McGraw-Hill Publishing Co., has kindly consented to act as judge in this contest.

Awards will be based on originality, attractiveness and strength of design. In case of a tie, prizes will be duplicated.

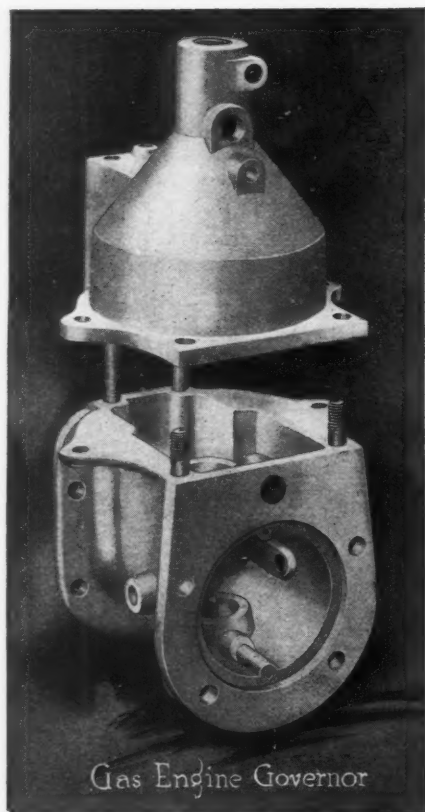
This offer is made by the manufacturers of **VENUS PERFECT PENCILS**, which pencils are available in 17 degrees from 6B softest to 9H hardest, and also hard and medium copying. The winners' names will be published in a later issue of this publication.

Send drawings to

American Lead Pencil Co.

237 Fifth Avenue

NEW YORK



Gas Engine Governor

Acme Die-Castings in Aluminum and White Metal Alloys

Accuracy Guaranteed

The Gas Engine Governor parts shown above are difficult die-castings. Their production in quantities strictly in accordance with specifications requires skill, experience and careful supervision and inspection. The parts must be solid and extremely accurate at a number of points—the finish must be perfect. We cite this merely as an example out of many hundreds of jobs we are turning out with complete satisfaction to our customers.

Acme Die-Casting Service is thoroughly dependable, the workmanship and materials measure up fully to the exacting standards of manufacturers of high grade products. This service awaits your order.

Acme Die-Casting Corporation

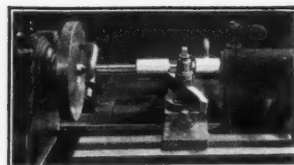
Bush Terminal Bldg. No. 5, 35th St. and 3d Ave.

Brooklyn, N.Y.

BOSTON
PHILADELPHIA
NEW YORK
ROCHESTER

TRADE MARK

DETROIT
CHICAGO
ST. LOUIS
PITTSBURGH



Back of the Battlefield

are marshalled the machines of production, straining to speed up their output.

Every minute that can be saved adds to the total supplies which can be turned out. If 2 to 10 minutes could be clipped off, every time the job on a lathe is changed, from two hours to a full day would be added to the output of each lathe each week.

How many lathes have you? Even two hours a week totals nearly two working weeks in a year.

Nicholson Expanding Mandrels are *instantly* adaptable to any sized hole from $\frac{1}{2}$ " to 7", round or square, even or tapered. They can be centered immediately and quickly removed. The outstanding time saver of the machine shop.

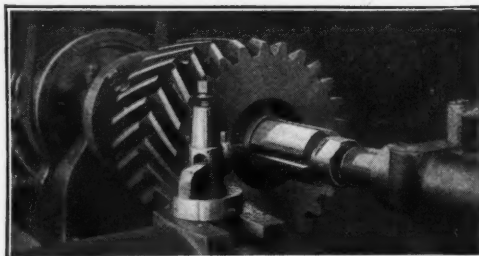
This is a backed-up statement. We will lend you one for thirty days' test without any obligation. The full charges will be ours.

W. H. Nicholson & Co.

112 Oregon Street

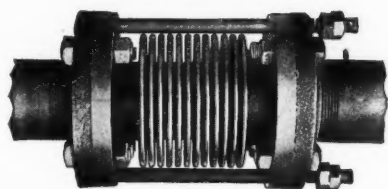
Wilkes-Barre, Pennsylvania

Nicholson Expanding M

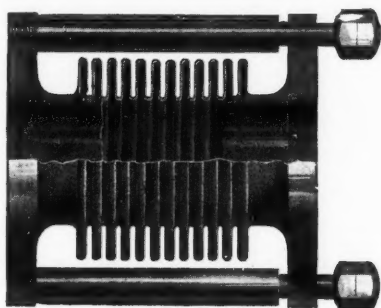


A
N
D
R
E
L

The Nuttall One Piece Expansion Joint



View of Joint Installed



Cross Sectional View

Here is the solution for pipe line expansion difficulties.

The Nuttall Expansion Joint is made in one piece, machined to extremely close dimensions from a solid, hammer-forged steel blank, then oil treated. Note the illustration showing the interior construction.

The joint is strong, non-leaking and bolts solidly into the line. Breakage from extreme expansion or contraction is cared for by an arrangement of limiting bolts equipped with sleeves. A sliding sleeve on the inside minimizes friction and helps support internal strain. In actual tests it proved itself fifty times more durable than ordinary expansion joints. It is made for all standard sizes of pipe and to accommodate high and low pressures, allowing a total movement of 2" on the high and $\frac{5}{8}$ " on the low pressure.

It retains all desirable features of other expansion joints but eliminates the objectionable points.

Write for circular.

NUTTALL
PITTSBURGH L

"Can't Afford" to Make Their Own Gray & Prior Universal Joints Are Both Better and Cheaper

That's the verdict of the manager of Deck Bros., Buffalo, N. Y., manufacturers of polishing machines. This concern used to make their own universal joints for transmitting power from the line-shaft to the machine. But that was before they knew of Gray & Prior Universal Joints. Once they tried G & P Joints they discontinued manufacturing their own. Today they have over 4000 G & P Joints in use and not a single case of trouble has developed. G & P Universal Joint parts are strong drop forgings with wearing surfaces carefully case-hardened. No play to collect dirt, generate friction and absorb power. Can *you* afford to make your own universal joints? We doubt it.



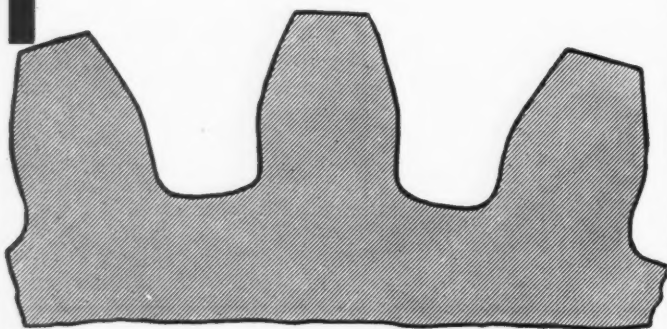
*Write for
descriptive literature*

**The GRAY & PRIOR
MACHINE COMPANY**
38 SUFFIELD ST. HARTFORD, CONN.



Long Service GEARING

is the result of specialized knowledge and specialized equipment such as is used in the production of



TRADE MARK

We furnish complete gears designed to give maximum service under your particular conditions or we cut your blanks according to your specifications.

20 years of experience in the manufacturing of better gearing exclusively has placed us in a position to give you positively the best gearing service to be found in the industry.

Ask our Engineering Department for suggestions as to your gearing.

**THE VAN DORN & DUTTON
COMPANY**

Gear Specialists

Cleveland

Ohio, U. S. A.



Don't Waste Your Men's Energy

THE hum of the shop is music in the ears of a good mechanic—but the jarring clash of metal on metal gears soon tires his nerves.

Controlling tired nerves consumes a lot of energy that would otherwise go to the work, and the quality and quantity of production suffers proportionately.

PEERLESS RAWHIDE GEARS AND PINIONS

increase the output at least 10 per cent on this count alone, mesh perfectly with metal gears and wear well under any service.

We cut gears of all kinds. Send us your specifications.

THE HORSBURGH & SCOTT CO.
CLEVELAND OHIO, U. S. A





BOSTON GEARS

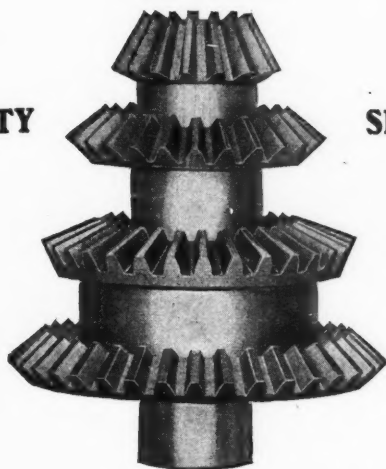
BOSTON GEAR WORKS, NORFOLK DOWNS (Quincy) MASS.
SEND FOR 1917 CATALOG

CROFOOT GEARS

STAND FOR

QUALITY

SERVICE



There is only one way to insure quality and service, and that is to have an up-to-date equipment and organization. We have both, and they are at your disposal.

May we have an opportunity to quote on your gear requirements?

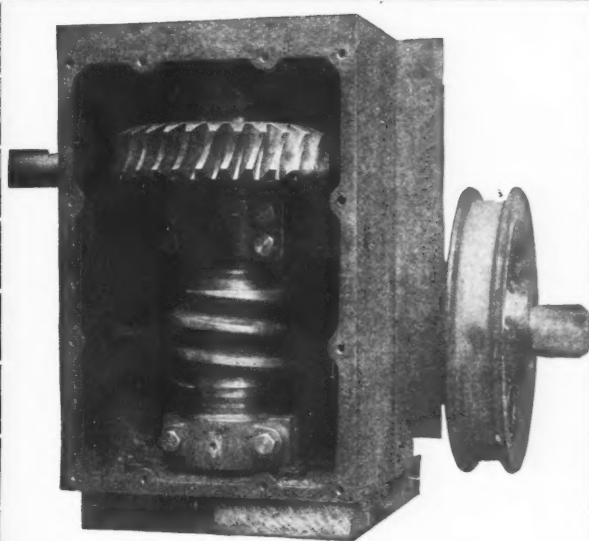
CROFOOT GEAR WORKS

INCORPORATED

31 Ames Street CAMBRIDGE "A" Branch
BOSTON, MASS.

HINDLEY WORM GEARS

SAFE — SILENT — EFFICIENT



Where gearing of close accuracy or great power—or both—is required, discriminating engineers specify Hindley Gears. Adapted for ignition mechanisms, mine haulage, driving automobile trucks—for any service where safety and efficiency depend on reliable gearing. Try us on your next order.

HINDLEY GEAR COMPANY

1105 FRANKFORD AVE. PHILADELPHIA, PA.

GEAR ECONOMY

ALL gears wear out eventually. Economically speaking, therefore, the vital consideration in buying gears is to buy gears that will give the longest service.

Grant Gears are durable even under severe usage. They are made from selected materials in a plant equipped to turn out quality gears. Grant carries in stock Iron Cut Gears, Brass Cut Gears, Cast Gears, and makes gears to order, all sizes from $\frac{1}{4}$ " to 6' diameter, any face. Reasonable prices, prompt deliveries and gears you can depend upon.

Send for Catalogue.

Grant Gear Works, Inc.

151 Pearl St. Boston, Mass.

ONE OF OUR GREAT SPECIALTIES HEAVY DUTY HARDENED GEARS

For General Use
and Machine
Tools

For
Tractor Truck
and Auto Drives
For
Transmissions
and Differentials

Get
Our
Prices
Before
You
Buy



The IXL
Cut
Gears
Lead

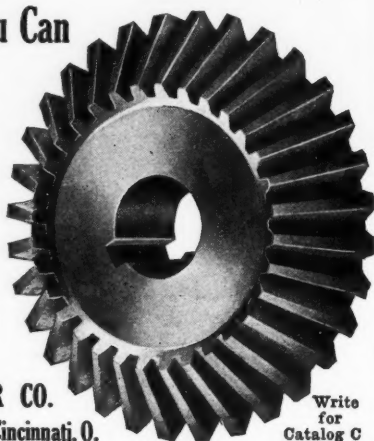
Write for Gear Problems No. B. R. 334 page catalog and price list FREE.

FOOTE BROS. GEAR & MACHINE CO.

Manufacturers of all kinds of Cut Gears
210-220 North Carpenter Street CHICAGO, ILL.

Gear Service You Can Depend On

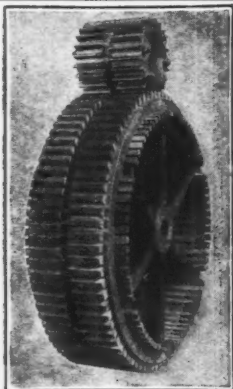
Complete satisfaction in any gearing emergency is the service we give—perfect gears of enduring quality in minimum time. Our whole organization is keyed to this form of service. Send your next gearing S.O.S. to us and watch the clock.



THE CINCINNATI GEAR CO.

1827-1833 Reading Road, Cincinnati, O.

Write
for
Catalog C



Equipped to Handle All Kinds of Special Machine Work

We make the unusual machinery that other shops are not now equipped to handle.

Nothing too large for
our equipment

Poole Engineering & Machine Co.

BALTIMORE, MD., U. S. A.

New York Office, 50 Church Street



BEVEL GEAR GENERATORS BEVEL GEARS

CUT THEORETICALLY CORRECT

Special facilities for cutting Worm, Spiral, Miter, Internal and Elliptical Gear Wheels

The Bilgram Machine Works

1231 Spring Garden Street Philadelphia, Pa.

FAWCUS HERRINGBONE GEARS

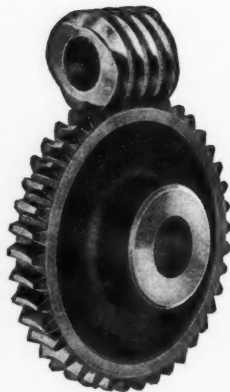
Mill Drives - Turbine Transmissions
Spur Gears - Bevel Gears - Worm Gearing
FAWCUS MACHINE COMPANY. PITTSBURGH, PA.



GEARS SPROCKETS WORMS, ETC.

manufactured true to
your specifications, sample or blue-
print.

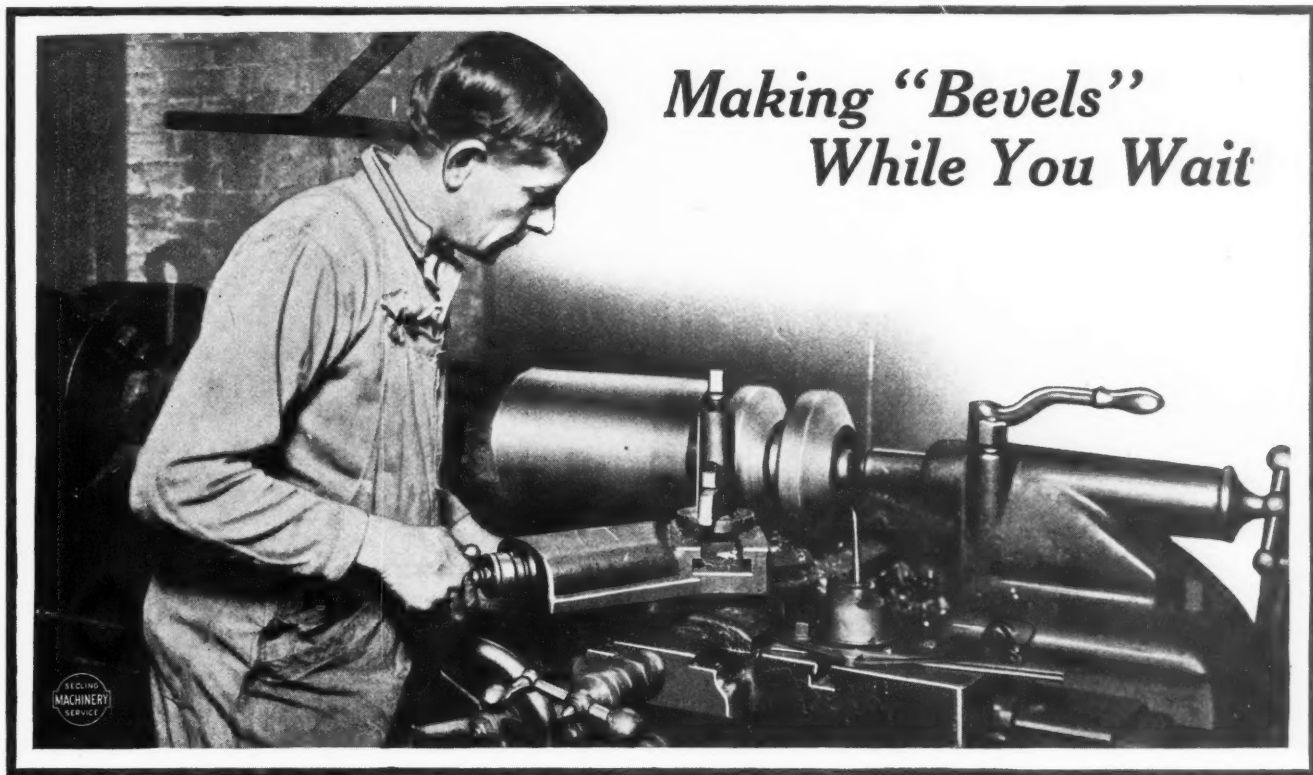
We have a modern shop equipped with modern automatic machinery especially suitable for making gears, etc., complete, or cutting the teeth in your blanks. We have had years of experience in this line of work, and can fill your orders promptly, accurately and at the right price.



Correspondence answered promptly.

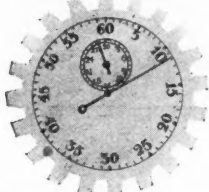
We Urgently Request You to Give Us a Trial

WOBBURN GEAR WORKS, Woburn, Mass.



*Making "Bevels"
While You Wait*

PHILADELPHIA
GEAR TIME



"Every Second Counts"

*Put Your Gear
Troubles up to
"Phillie Gear."*

PHILADELPHIA GEARS

The reason that "Phillie Gear" can turn out an order of bevel gears in such short time is due not only to shop organization, good equipment and well-trained men, but also to the stocking of a great many sizes of the finest of forged steel bars. This stock is conveniently arranged and the first procedure in putting through a batch of "bevels" is to pick out a forged bar the size required, deliver it quickly to the machine room, and presto, it takes the form of bevel gear blanks before your very eyes.

It is doing the desired thing just a little better and in better time than the other fellow that has given "Phillie Gear" and his organization their present reputation. Why not try Philadelphia Gear Service?

PHILADELPHIA GEAR WORKS

VINE AND 11th STREETS

PHILADELPHIA, U. S. A.



NEW PROCESS GEARS

Use Them Anywhere

When you want gears that are absolutely dependable, that are uniformly good, that will stand up to severe service without fail, choose NEW PROCESS GEARS and you can't go wrong.

We make them in all styles—spur, bevel and spiral, in steel, iron or brass, large or small—and will supply any quantity, one gear or ten thousand.

Send us your blueprints for quotation, and you'll wonder why you have been cutting your own gears for so long.

 **NEW PROCESS** 
GEAR CORPORATION
SYRACUSE, N. Y.

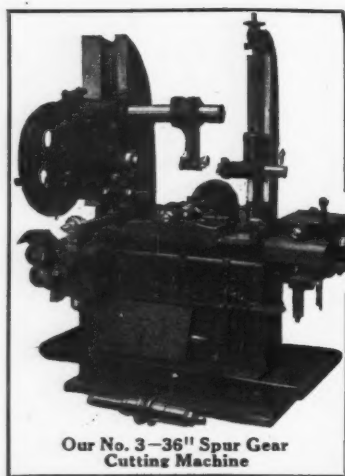
152



We not only make good gears, but we make good gears at low cost. One trial order is all we ask.

NEWARK

Gear Cutting Machines



Our No. 3-36" Spur Gear Cutting Machine

Accurate, productive, durable machines; built by skilled labor; materials carefully selected; automatic in operation.

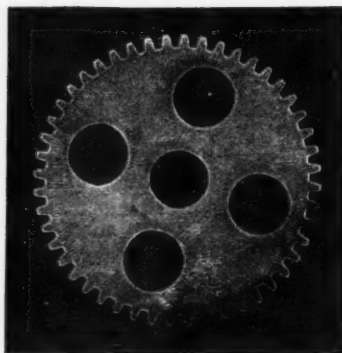
Buy them for gear cutting, for cutting sprockets, ratchet wheels, circular saw teeth and other similar work. Write for Catalog.

NEWARK GEAR CUTTING MACHINE CO.

Gear Specialists

69 Prospect St.

NEWARK, N. J.



GENERATED

in our

Gear Cutting Department

(Cut is full size)

Let Us Quote You

MEISSELBACH-CATUCCI MFG. COMPANY
27 CONGRESS STREET NEWARK, N. J.

ACCURATE CUT GEARS

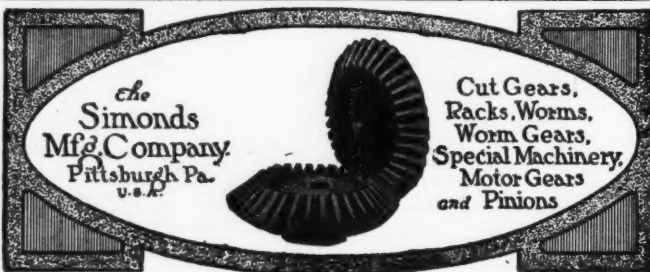
of every description in any material

SPUR, SPIRAL, HELICAL, INTERNAL, WORM

We Specialize in

MICARTA BAKELITE GEARS

BRAUN GEAR WORKS 1321 GATES AVE. BROOKLYN, N. Y.





Consider This—

High-speed, motor-driven shears, presses, punches, etc., demand extraordinary service from the gears used with them. Aside from the wear induced by high-speed operation itself, the intermittent work such machines perform—running free one moment and laboring under full load the next—reacts violently and destructively on the gear teeth and unless provided against rapidly leads to wear and in many cases to costly breakage of the gears.

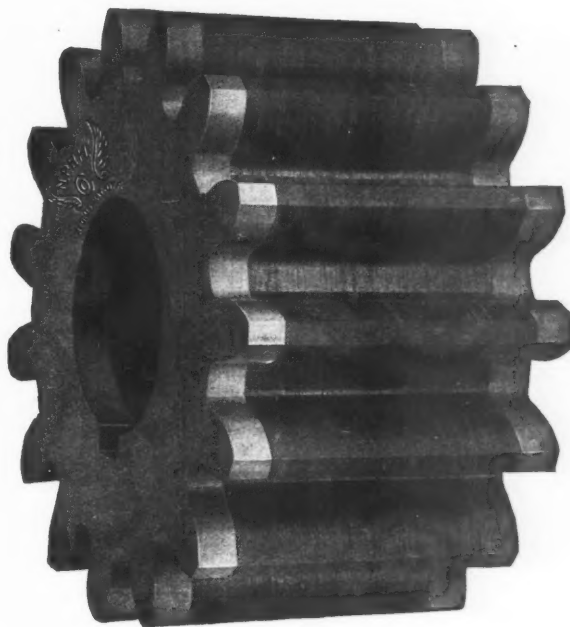
NEW PROCESS NOISELESS PINIONS

used in such service offer an ideal remedy to both these conditions.

Cut from rawhide, especially cured by exclusive process for gear requirements, NEW PROCESS NOISELESS PINIONS have a resiliency in service that metal gears, no matter how well oiled, greased or lubricated, can never acquire. This characteristic resiliency acts as a cushion to absorb the sudden shocks of heavy service and will protect the whole gear train against crystallization and tooth fracture.

More than that—*there is no ring to rawhide*. NEW PROCESS NOISELESS PINIONS, no matter how worn—and they will outwear metal gears in many cases—can *never* become noisy. The ringing, rattling roar that is such a nuisance and source of expense with ordinary metal-to-metal gear drives is permanently absent when NEW PROCESS NOISELESS PINIONS are in use.

They are cut to suit every motor drive requirement. Ask for our booklet—*Noiseless Gear Driving*. It is worth a thorough reading.



NEW PROCESS
GEAR CORPORATION
SYRACUSE, N. Y.



CANADIAN AGENTS: Robert Gardner & Son, Ltd., Montreal, Que.



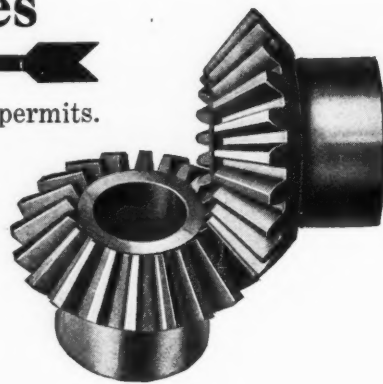
This Mark Guarantees

gears of the highest grade at prices as low as quality permits.

It also guarantees prompt delivery. We furnish gears for driving all manner of delicate mechanisms, and for hard, heavy service in the industrial field. *We have never lost a customer.* Let us show you why.

Try us also for Automatic Screw Machine products up to 5½" diameter.

Meisel Press Manufacturing Company
948 Dorchester Avenue BOSTON, MASS., U. S. A.



"Zones of Quiet"

Accurately Generated GEARS

Wherever you find Albaugh-Dover Accurately Generated Gears in use, you are sure to be impressed with their unusual smoothness and silence in operation. Our gears are used by many of America's leading manufacturers of automobiles, trucks, tractors and other machinery. If you use gears—SPIRAL, HELICAL, INTERNAL, WORM OR WORM WHEELS—send us your blueprints or sample gears for estimates. We operate our shops continuously day and night in three shifts of 8 hours each, insuring exceptional service.

ALBAUGH-DOVER CO.
2100 Marshall Blvd. Chicago, Illinois

Forged Gear Blanks

Made from open-hearth steel of any carbon, nickel steel, chrome-nickel steel and chrome vanadium—any size, any amount.

Blanks that will enable you to guarantee, *absolutely*, gear quality in any machine you make. We've been forging gear blanks for a long time and have saved money for concerns the country over. Let us show you what we can do for you.

Send your specifications today.

THE MACHINERY FORGING COMPANY

Hamilton Ave. and Marquette St.
CLEVELAND OHIO, U. S. A.

IXL CUT GEARS—The Best

PROVEN BY TEST

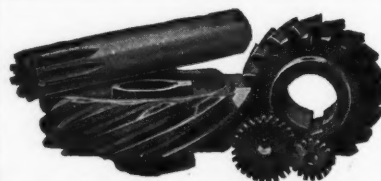
Made in the largest plant in the Middle West



MODERN MACHINES
MODERN METHODS

Write for THE NEW GEAR PROBLEMS No. EN—384-page catalog Free

FOOTE BROS. GEAR & MACHINE CO.
210-220 N. Carpenter Street CHICAGO, ILL.



Gears and Gear Cutting

We guarantee satisfaction

RODNEY DAVIS, Philadelphia, Pa.

ACME GEAR WORKS, Inc.

53 MILLS STREET

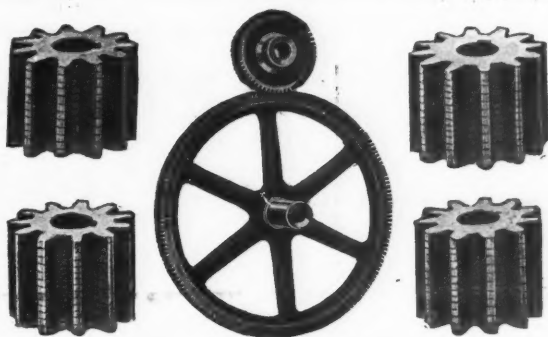
ASTORIA

LONG ISLAND

STAHL GEARS

Good gears—either metal or rawhide; gears absolutely as per specifications—material, workmanship, delivery; gears of standard quality—for uniform service—made by

STAHL



THE STAHL GEAR & MACHINE CO.
1390 E. 40th St. CLEVELAND, OHIO

Metal and Rawhide

Metal Gears—Spurs up to 60" dia., 2 D. P.; Bevels up to 24" dia., 1 3/4 D. P.; Spirals and Herringbone gears up to 19" dia., 3 D. P.; Worms up to 18" dia., 3 D. P.; Racks 8' long, 4 D. P. Rawhide Gears—any requirement up to 15" dia., 2 D. P.

TRY US



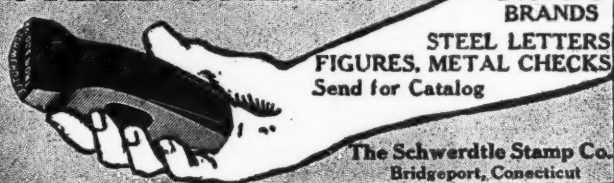
Good tools are essential regardless of the skill of the machinist. With Union Tools every element of guesswork can be eliminated, less work will be spoiled, production naturally can be greatly increased. Union Tools brace up standards unconsciously—and the line is complete; good tools for every purpose. *Send for particulars.*

HINDLEY WORM GEARING

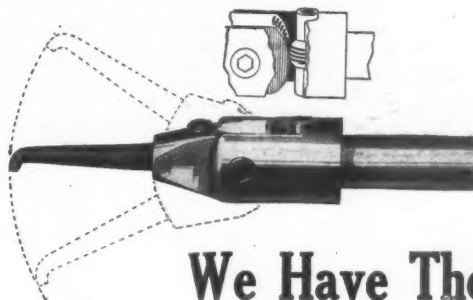
Complete drives with
housing ready for power

ALBRO-CLEM ELEVATOR COMPANY
701 GLENWOOD AVE. PHILADELPHIA, PA.

STEEL STAMPS



You Need Them—



We Have Them

For milling and boring you need
accurate Spacing Washers and
the E-Z-Set Boring Tool.

We have both—the Washers three, four, five and six thousandths thick, \$3.00 per 100 (25 of each). The E-Z-Set Boring Tool in three standard sizes, with provision for rigid clamping and worm actuated adjustment to secure fine variations. Adapted for screw machines, lathes, drill presses, etc., a time saver on tool work and in general manufacturing.

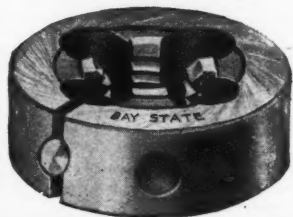
*You Need Them—
We Have Them*

Maxwell-Hutchcroft Co.
4227 Lorain Avenue
CLEVELAND OHIO



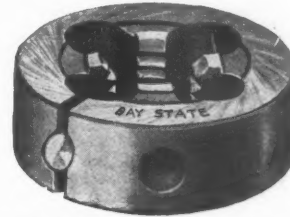
YOU CAN'T JUDGE BY APPEARANCES

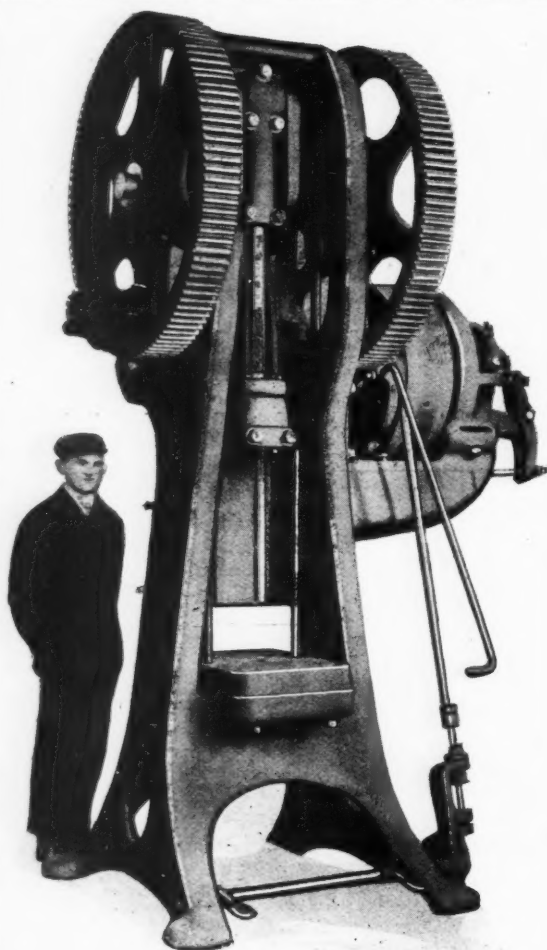
There are two ways to select tools—try them, or buy from a house of established reputation. Our reputation is second to none. We carry in stock a complete line of Taps, Dies and Screw Plates, and our name on a tool is sufficient guarantee for anyone who knows us. We guarantee our tools and our tools guarantee repeat orders. *Send us your next. Complete catalog on request.*



BAY STATE TAP & DIE COMPANY
MANSFIELD MASSACHUSETTS, U. S. A.

REPRESENTATIVES FOR ENGLAND: Geo. W. Goodchild & Macnab,
56-58 Eagle St., Southampton Row, London, W. C. REPRESENTATIVES
FOR SCANDINAVIA: Wilh. Sonesson & Co., Ltd., Malmö, Sweden.





EARLE GEARS

for Durability

Earle Gears have become well known as *accurate* gears. They are *durable* gears also—partly because they are made of selected materials, but principally because they are accurate gears. Accurately cut gears wear evenly, they run silently, they mesh perfectly, they transmit the maximum of power—and they are durable for these reasons.

Earle Gears are used by the largest users of gears as well as by the users of the largest gears—for all manner of transmissions. There must be reasons.

Let us show you.

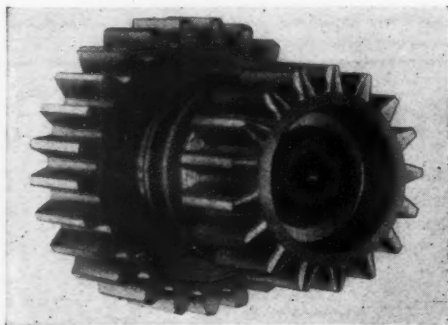
THE EARLE GEAR & MACHINE CO.

4705 Stenton Ave.

Philadelphia, Pa.

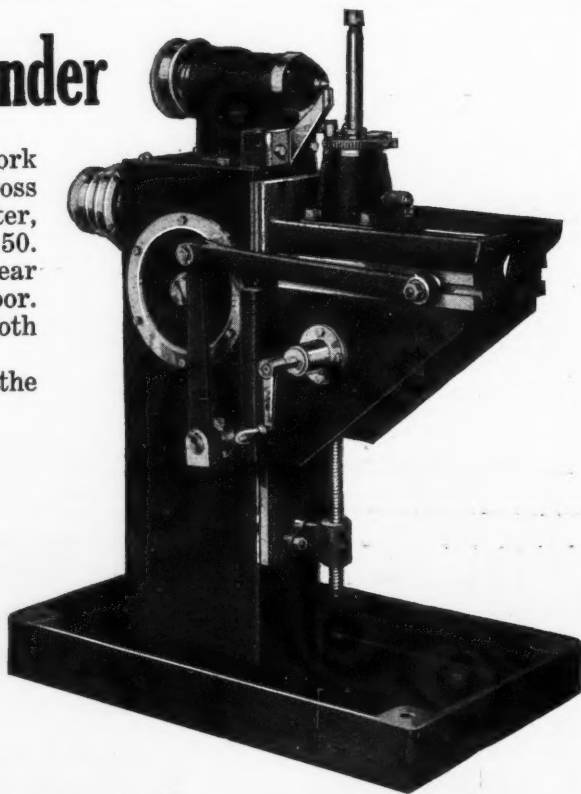
The Cross Gear Tooth Rounder

Rounds the teeth of sliding meshing gears; does its work accurately and sets a fast pace for speed. The Cross Tooth Rounder handles spur gears up to 30" diameter, any pitch from 2 to 20, any number of teeth from 8 to 50. It rounded the 5 pitch, 17 tooth chrome nickel steel gear we are showing in one minute ten seconds, floor to floor. If you make sliding gears you need the Cross Tooth Rounding Machine to give them the finishing touch. The machine has other uses—removes burrs left by the cutter, takes off sharp corners left by the hob.



Bulletin is interesting.

Tell us where to send it.



CHARLES H. WALKER, Detroit, Michigan
Corner 14th and Grand River Avenues

Alfred Herbert, Inc., 30 Church St., New York City, Sales Agents for the Eastern States. Alfred Herbert, Inc., Coventry, England, Sales Agents for Great Britain. Allied Machinery Co. of America, Turin, Paris, Zurich, Petrograd, Sales Agents for Europe.

BRONZE WORM GEARS

For Severe Service and High Efficiency

Gear blanks must be of a uniform hardness throughout, not only around the periphery, but also through the section of the teeth. Although the finished blank is of quite uniform cross section, the cast in the mold is not so, because of the heavy headers used.

At these points a much heavier cross section sets up a very much more open grain when sand cast in the regular way, hence when the blanks are hobbled the softer portion causes a different pitch to be generated. Furthermore, these heavy worm gear sections set up a very much coarser grain in the center near the root of the tooth, although the metal at the tip of the tooth is a very fine grain.

It has always been recognized that a spur gear was improved by casting the teeth in since the "skin" was deep enough to leave a fine uniform grain around the tooth sides after cutting. This fine grain therefore has always been recognized as an improvement. However, on worm gears it is not common to cast the teeth in, hence we have to carry the chilling effect deeper than sand will do ordinarily.

Our chill cast gear blanks have this fine grain carried well past the root of the teeth of even the largest worm wheels.

The beneficial results of the chilling process very largely contributed to the recent success of worm gearing of high efficiency.

A very uniform gear can be generated which is much more quiet and which, since the compressive strength is also increased, will retain its original tooth form.

The machining qualities are improved by our chilling process which does not give an objectionably hard skin, but is a process of cooling the mass of metal quickly and evenly throughout, producing a fine uniform grain to the desired depth.

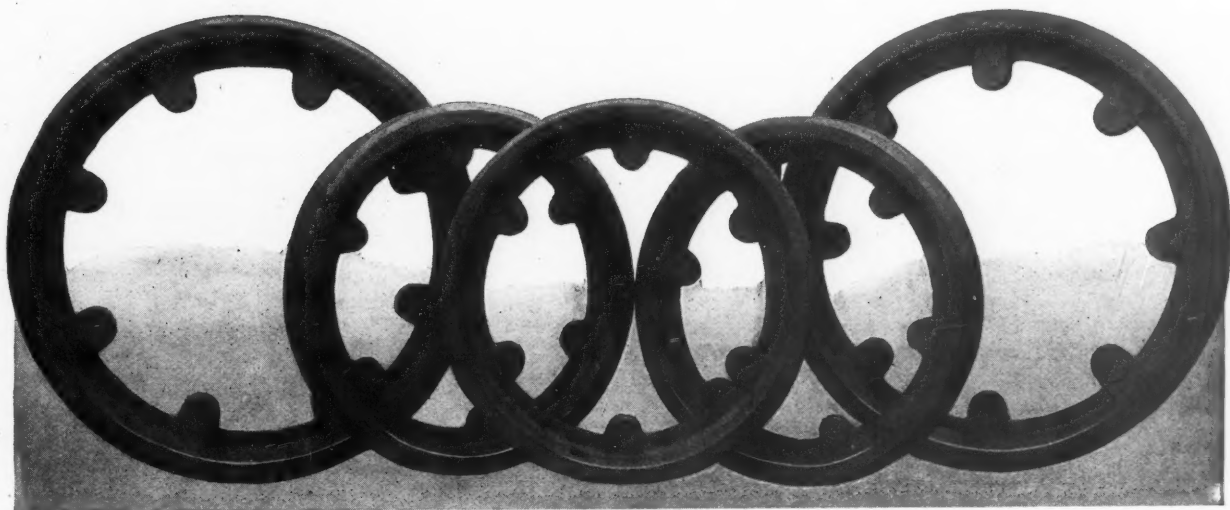
We have carefully studied the English as well as the American practice in worm gearing, and are familiar with the alloys giving satisfaction.

This is a specialty which we have developed to a very high degree. We would be glad to study your worm gear conditions and submit our recommendations as to the proper alloy for your use.

TITANIUM ALLOY MFG. CO.

WORKS: NIAGARA FALLS, N. Y., U. S. A.

BRONZE SALES DEPARTMENT
504 MARINE BANK BLDG., BUFFALO, N. Y.



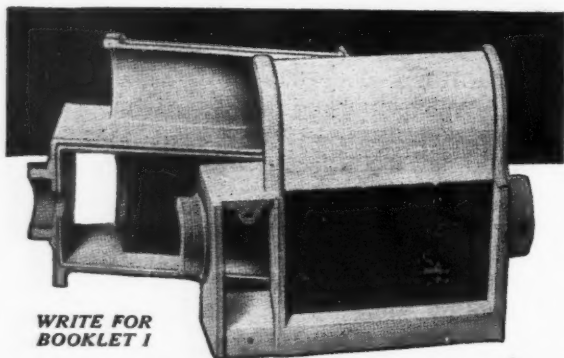
FRANKLIN DIE-CASTINGS

The Link Between
EXPERIMENT & FINISHED PRODUCT



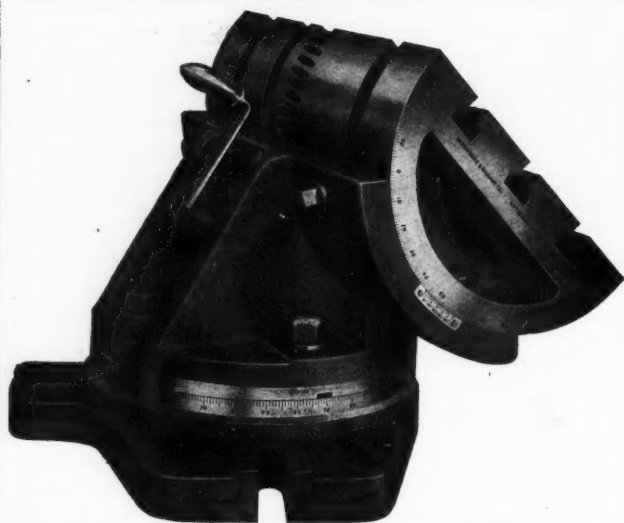
The Franklin Die-Casting Process is the Direct Way to Results

The advantages of die-casting over the usual forms of machining have become a recognized fact. A die once constructed insures for all time a degree of accuracy and uniformity difficult to secure except through expensive machine operations, at the same time eliminating the necessity of costly machine equipment. This is of special advantage in the development of new inventions or the meeting of rapidly increasing demands.



WRITE FOR
BOOKLET I

FRANKLIN MANUFACTURING CO.
SYRACUSE 738 Gifford Street NEW YORK



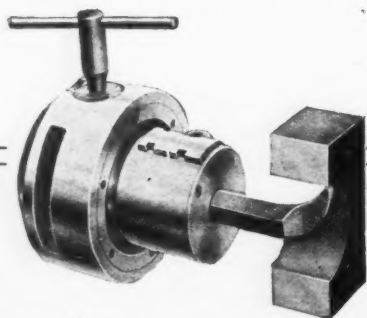
Universal Angle Plate

A little device for shop use that has practically unlimited possibilities of application on lathes, planers, milling machines, shapers, drill presses and grinders. Capable of movement through 360° horizontally and 90° vertically; a thoroughly practical tool that will give quick adjustment to any angle without disturbing the work. Its usefulness will be apparent to every wide-awake owner who appreciates the difficulty of getting accurate results from makeshift, inaccurate devices.

Detailed Information on Request

BOSTON SCALE & MACHINE COMPANY
381-389 Congress Street BOSTON, MASS.

TRY A Casler Offset Boring Head AT OUR EXPENSE



We'll send the size best suited to your work and let you use it for thirty days just as you please. Test it thoroughly; compare the cost of operation and quality of work with those of other boring devices you've used; then, if it hasn't come up to expectations, send it back. You run no risk.

Free details of the offer on request. May we hear from you?

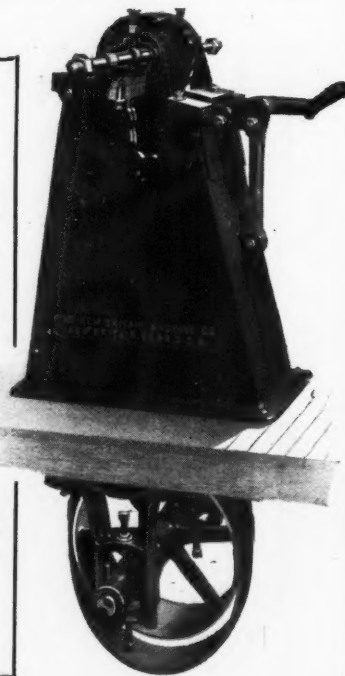
MARVIN & CASLER COMPANY
CANASTOTA NEW YORK

"NEW BRITAIN" DROP-HEAD POLISHING MACHINE



DRIVE from below makes this an all-around safe machine. The belt is entirely enclosed—the operator is safe from the belt and the belt is safe from dust, oil and grit. Countershafts, loose pulleys, idlers and over-head belts are eliminated and the spindle is pulled down into solid part of box—all of which makes the machine smooth running, convenient and productive.

Write for complete description.



The New Britain Machine Company
NEW BRITAIN, CONN., U. S. A.

BARKER

Wrenchless Chucks Increase Output on Any Work, Any Machine, Under Any Condition

A big claim to make for any chuck; but the "Barker" has proved its case by what it has actually done and is doing.

Barker Chucks have been skeptically received in more than one plant where they have later been retained as regular equipment. A Barker Chuck increased average daily output on differential cages from 45 to 64 for a motor car company that thought 45 per day remarkably good. In a plant where brass ties were turned out at the rate of 375 per day, another "Barker" ran the figures up to 625 per day—a 66.6 per cent increase. So it goes through a long list.

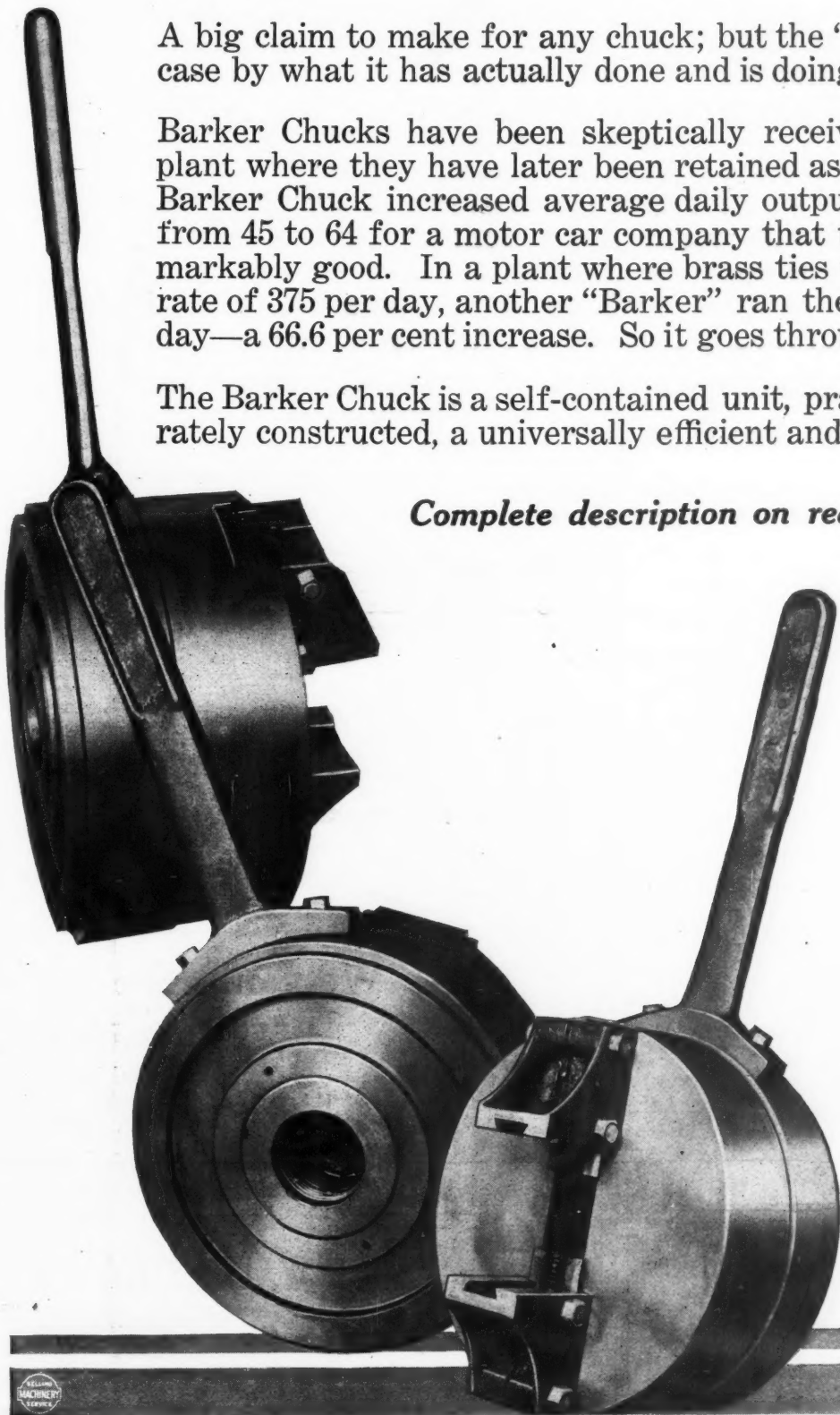
The Barker Chuck is a self-contained unit, practical in design, accurately constructed, a universally efficient and economical chuck.

Complete description on request.

We'll be glad to tell
in detail the special
advantages of Barker
Chuck construction.
Write us.

**Thomas
Elevator
Company**

22 SOUTH HOYNE AVE.
CHICAGO ILLINOIS



In Selecting Stamping Dies Examine the Bevel



The life of Steel Marking Dies is largely determined by the bevel. A long, narrow bevel requires only a light blow—but it soon wears down and must be discarded.

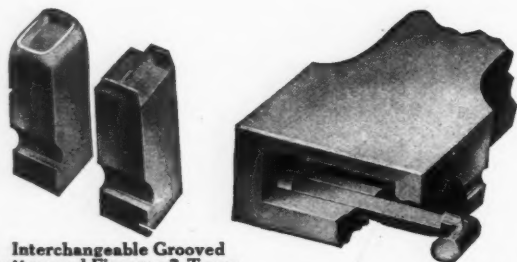
MATTHEWS STEEL CUT DIES

are the short, "stubby" kind. They need a forceful blow—but will outwear a dozen of the others.

An uneven bevel brings too much pressure on one side and the figure soon breaks down—often at the first blow.

Matthews Dies are hand cut from the best Pittsburgh steel. They are absolutely uniform and Matthews guarantees them for long and satisfactory service.

*All Kinds of Marking Devices
Send for Catalog*



Interchangeable Grooved
Letters and Figures—3 Types.
Champion Steel Holders
3 Styles

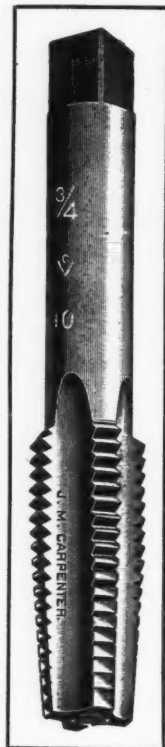
Jas. H. Matthews & Co., Inc.

Established 1850

3946 Forbes Field, PITTSBURGH, PA.

Canadian Distributors—Canadian Fairbanks-Morse Co., Ltd.

Carpenter



Look for the name when you buy taps and dies. It means investing in 47 years of tap and die experience.

CARPENTER TAPS

cut true threads and retain a lasting cutting efficiency even under the harshest conditions. If there's need for better thread cutting in your work, try "Carpenter" next time. You'll remember the name, but it is just as well to keep a catalog on file.

**The
J. M. Carpenter
Tap and Die
Company**

PAWTUCKET RHODE ISLAND



VALEAU FILES

We Can Make Early Deliveries

Fine files for toolmaking or manufacturing purposes, accurately cut, uniform in quality.

Considerable quantity and various sizes on hand from which we can make prompt deliveries.

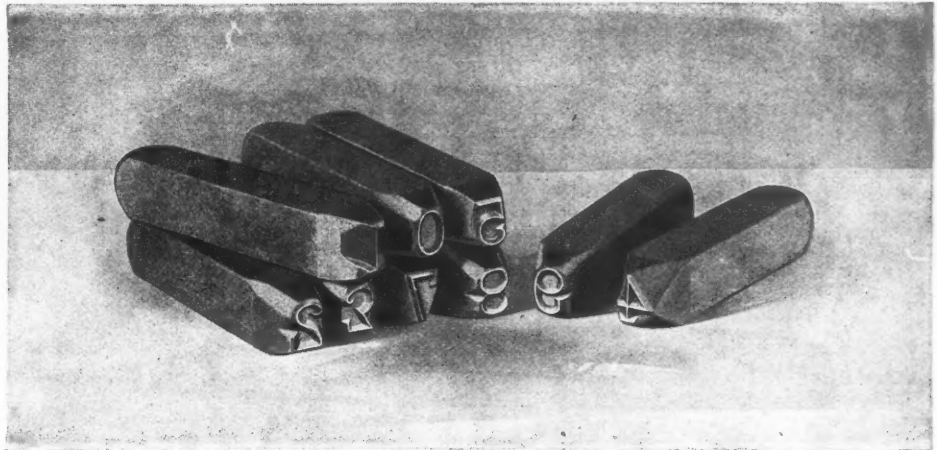
T. P. WALLS TOOL CO.

SOLE AGENTS

75-77 Walker St., NEW YORK

For Clear Markings and Long Service

PANNIER BEVEL STAMPS



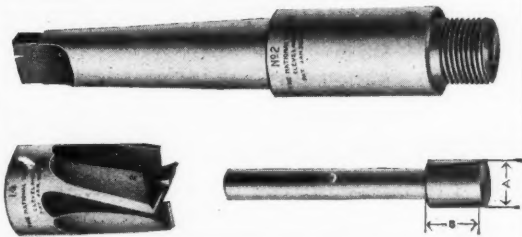
*Prompt
Shipments*

Our Advisory and
Consulting Service
are yours for
the asking.
Catalogue on
Request.

Pannier Steel Bevel Stamps are designed by men who know the exact mathematical degree of balance between maximum efficiency and maximum wear—who turn out stamps that cut a clean, deep impression, and are still strong enough to stand up under hard work. Pannier Stamps are made of best grade tool steel, from blanks sawed from cold bars just as they come from the mill. They receive only *one heating*—that in the tempering furnace. Grinding, cutting, tempering are done by expert steel workers.

We guarantee every Pannier Stamp against defect in material or workmanship

PANNIER BROS. STAMP CO., Inc.
PITTSBURGH, U. S. A.



Reducing Your Tool Bill with the NATIONAL Counterbore

The price of tool steel is soaring—there's no telling where it will stop. You can't do without it—the best you can do is to use no more than you need.

THE NATIONAL PATENT INTERCHANGEABLE COUNTERBORE demonstrates the value of this practice applied to tool making. Of the three interchangeable parts, only the cutter is high speed steel. The pilot and shank are made of strong, durable, but less expensive steel—saving No. 1. The cutter is always the part that wears. If it's a "National," *only* the cutter need be renewed—saving No. 2.

If you are interested in reducing your tool bill, write for circular.

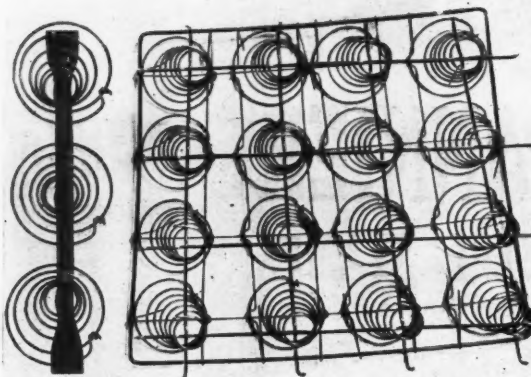
MANUFACTURED BY

THE NATIONAL TOOL CO., Cleveland, Ohio





SPRINGS



Coil Springs of Every Kind

Prices Right
Superior Service
Exceptional Facilities

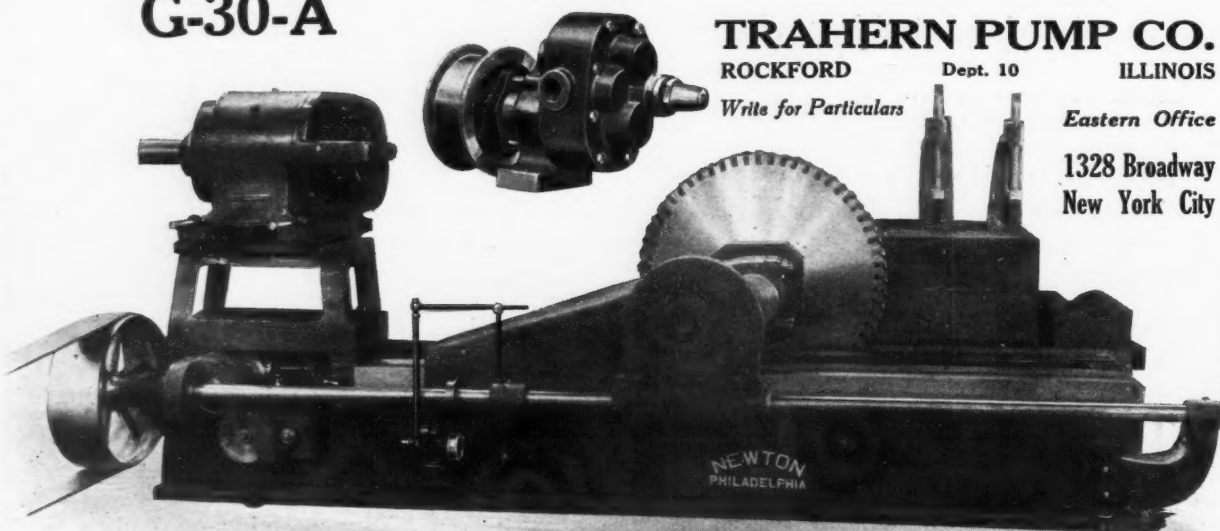
Send us your blue prints or samples for estimates.

Kokomo Spring Company

Kokomo, Indiana, U. S. A.

A Trahern Cools this Saw that Cuts Bethlehem G-30-A

This machine is designed to cut a beam 30 inches deep, weighing 200 pounds to the foot, and having a cutting area of 58.85 square inches. The manufacturers, the Newton Machine Tool Works, Inc., say: "The fact that it supplies enough lubricant to carry off the heat generated by such a large blade, testifies to the practicability and capacity of the mechanism of the pump." TRAHERN ROTARY GEARED PUMPS will do as well for you.



TRAHERN PUMP CO.

ROCKFORD

Dept. 10

ILLINOIS

Write for Particulars

Eastern Office

1328 Broadway
New York City

A Cold Drink for the Industrial Army

There's a great deal of sympathy extended to the men in the trenches who suffer from thirst; but little if any goes to the men in the rank and file of manufacturing—the trench workers of the nation's industries. Shop work is hot and tiresome—a cold drink now and then sets a man up amazingly.

"Meeco" Bubbling Ice Water Fountains are as necessary to maintain uniform production in your plant as your lighting, ventilating and transportation systems. Take care of your men and they will take care of the work.

For attachment to municipal water supply. Holds 75 pounds of ice. 15½ coils of ½" seamless brass tubing. Serves 150 persons.

Our Lines Include: Sanitary Wash Bowls (in Batteries), Bubbling Fountains (Plain and Ice Cooled), Metal Lockers, Metal Stock and Pattern Storage Racks, Metal Shelving, Metal Cabinets, Vault Fixtures, Soda Kettles (40 and 60 Gallons), Metal Stools and Chairs, Water Mixers, Work Benches, Bench Legs, Full Line of Plumbing Fixtures, Etc.

Manufacturing Equipment & Engineering Company

Works and Mail Address:
FRAMINGHAM, MASS.

Office and Showrooms:
BOSTON, MASS.



Send for
Complete
Catalog of
"Meeco"
Specialties.

Stuebing LIFT TRUCKS

"THE CHOICE OF THE GREATEST INDUSTRIES"



CUT HANDLING COSTS

One man can do the work of five—if you give him a Stuebing Lift Truck.

Get the benefit of the experience of such concerns as Good-year Tire and Rubber Co., Winton, American Tool Works, Firestone Tire and Rubber Co., Hoosier Spring and Axle Co., American Can Co., Ferracute Machine Co., Linderman Machine Co., Continental Motors Co., Ford, Studebaker, Chandler, U. S. Government, and hundreds of others who have selected Stuebing Trucks.

Ease of operation—high lift—steel construction—positive hydraulic check—make them "The Choice."

Free trial in your own plant. Get our book "SYSTEM IN TRUCKING."

Write now!

THE STUEBING TRUCK CO.
CINCINNATI, OHIO, U. S. A.

Men Who Plan and Design
Must Preserve Their Physical
Endurance. Avoid Unsteady
Tables, Haphazard Filing
and Use the Economy Way.

Economy is
Harmony

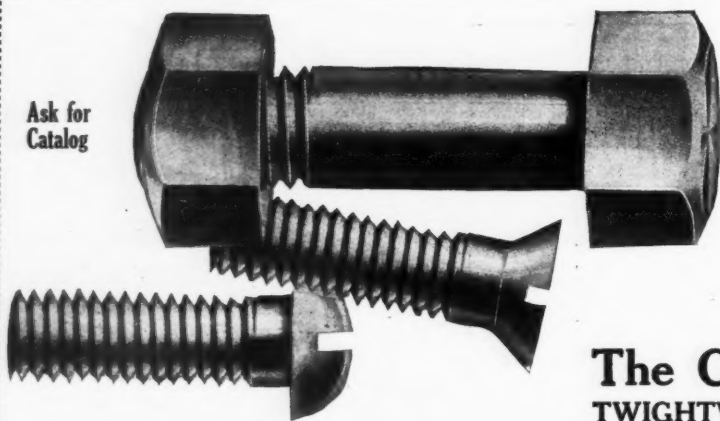
Standard Sizes:
26 x 38—32 x 44 Inches



ECONOMY DRAWING TABLE CO.

Drawing Tables and Filing Cases in
Steel and Wood

TOLEDO : : OHIO

Ask for
Catalog

Screw Machine Products for Twenty Years

We make any kind of screw machine product—any metal—any size up to 4 inches in diameter.

We carry in stock a full line of standard screws, studs, bolts and nuts; also a full line of Ford accessories.

We solicit specifications from which we are prompt in furnishing estimates and making deliveries.

All screws U.S.S. thread unless otherwise specified.

The Cincinnati Screw Company
TWIGHTWEE (Cincinnati Suburb) OHIO

HIGH **ON** SPEED

Trade Mark

SHIP your high-speed steel scrap to us. We'll grade it; remelt it; forge it to the size bars you need—adding any Tungsten or other material needed to raise it to the high standard of

ONONDAGA PROCESS

High Speed Steel. Every bar trade marked as above; the best high speed steel you ever used.

Write for more information.

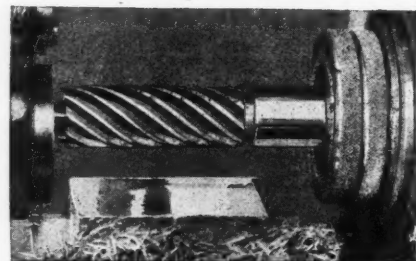
ONONDAGA STEEL COMPANY INC.
SYRACUSE, N.Y.

STEEL BEARING BALLS



THE ABBOTT BALL CO.
Elmwood Hartford, Conn.

For Heavy Cuts in Tough Stock



you can be sure of tool stamina if you use service-guaranteed

Windau Tools

The line includes High Speed Spiral Milling Cutters, Form Milling Cutters, Circular Tools and Special Small Tools.

Write for Quotations.

WINDAU TOOL COMPANY
1318 ADDISON ROAD CLEVELAND, OHIO



Testing a die for Hardness (Scleroscope on Swing Arm)

Have You a Scleroscope to Test Your Metals?

For Softness, Hardness or Strength

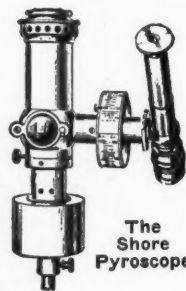
Can be operated by non-technical help. The majority of manufacturers are thus ordering their material to specifications, as to quality and fitness, meaning that the minority who have not a scleroscope to inspect their material may have to accept the discard of their more up-to-date competitors. It shows if you are getting what you pay for out of your tool steels. Send for our 80-page booklet. Free.

THE PYROSCOPE OPTICAL PYROMETER

If your heat troubles are still unsolved, investigate the pyroscope, the one common-sense instrument that makes straight for results without fuss. Extreme simplicity—constancy—always ready. Pamphlet on request.

SHORE INSTRUMENT & MFG. CO., Inc., 555-557 W. 22nd St., New York

FOREIGN AGENTS: Agent for Great Britain and Colonies, Coats Mch. Tool Co., Ltd., Caxton House, London, S. W.; Glasgow; Newcastle-on-Tyne. Schuchardt & Schutte, Tokyo, Japan. Ignoskoff & Co., Petrograd, Russia. Aux Forges de Vulcaïn, Paris, France. R. S. Stokvis & Zonen, Ltd., Belgium and Holland.



The Shore Pyroscope

**"MULTI-UNIT"
SECTIONAL
STEEL
SHELVING**



**"A Place
For
Everything
And
Everything
In Its
Place"**

On Board U.S.S. MELVILLE

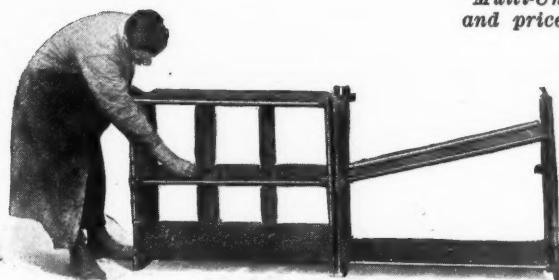
THIS vessel, which has served as Headquarters for Vice Admiral Sims and Mother Ship of the Destroyer Fleet now operating in European waters as submarine chasers, went abroad equipped with "Multi-Unit" Steel Shelving for the storage of repair materials, etc., needed by the fleet.

SUPER-STRENGTH, standardized steel units which can be quickly assembled into stacks of plain shelves or bin compartments of various dimensions.
Construction:—Extra heavy sheet steel with strengthening tubular edges of pleasing design.

Finish:—Furnished in plain steel for rough storage or in olive green, dark green or black enamels for offices, stores, warerooms or storerooms where handsome appearance is a factor.

First cost is the last cost. "Multi-Unit" is the economical, efficient shelving.

"Multi-Unit" Bulletin MD
and prices sent on request.



Showing the Method of Assembling Units

NATIONAL SCALE CO.

(Standard Steel Shelving Division)

8 Mechanic St., Chicopee Falls, Mass.

Manufacturers of National Counting
Machines and National-Chapman
Elevating Trucks

FOREIGN REPRESENTATIVES: S.
Haug Ellingsen & Co., Christiania,
Norway. Burton, Griffiths Co., Ltd.,
London, England. H. Brennelson & Co.,
5 Jules Ferry Boulevard, Paris, France.



Not Bric-a-brac. Built for hard
service. Use it like a ladder
to reach the top-most bin.

Don't Experiment with Wrenches—Buy "Coes"



A "Coes" Wrench never slips—never rounds the corners of a nut—never jams the thread. You can depend on a "Coes"; it is stronger by 30 per cent than any similar wrench on the market; it is the choice of experienced mechanics all over the world.

"Coes" Wrenches are made in five styles and a wide range of sizes—order by name from your dealer.

"Coes" Steel Handle Model, 4" to 21" sizes; Knife Handle, the general utility "Coes," 6" to 21" sizes; Key Model "Coes," 28", 36", 48" and 72" sizes.

COES WRENCH COMPANY, Worcester, Mass., U. S. A.

AGENTS: J. C. McCARTY & CO., 29 Murray Street, New York.
438 Market Street, San Francisco, Cal. 1515 Lockmer Street, Denver, Colo.

AGENTS: JOHN H. GRAHAM & CO., 113 Chambers Street, New York.
London, E. C., 118-122 Holborn, for Great Britain and Continental Europe.



See our agents or write
to us direct

Advance Machine Tools

Quality and Good Delivery at a Fair Price

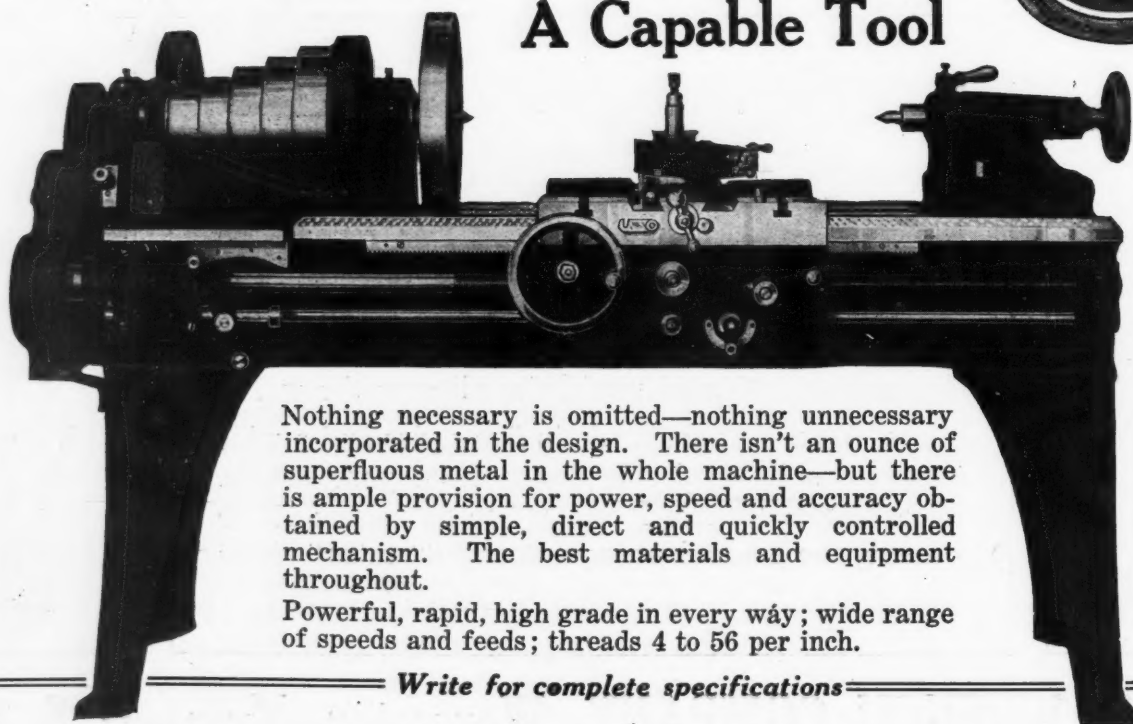
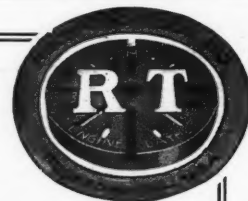


Universal Machinery Company

Manufacturers of Advance Machine Tools

MILWAUKEE, WIS., U. S. A.

The Rockford 15" Engine Lathe— A Capable Tool

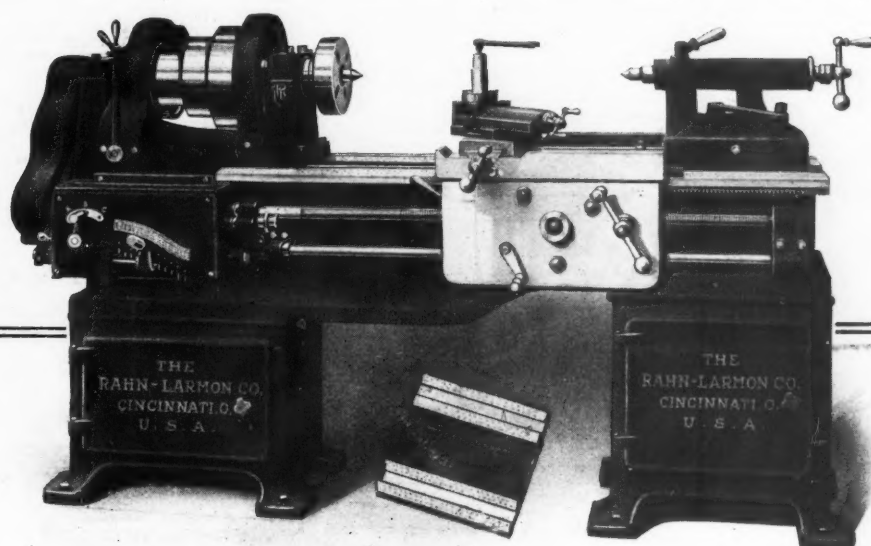


Nothing necessary is omitted—nothing unnecessary incorporated in the design. There isn't an ounce of superfluous metal in the whole machine—but there is ample provision for power, speed and accuracy obtained by simple, direct and quickly controlled mechanism. The best materials and equipment throughout.

Powerful, rapid, high grade in every way; wide range of speeds and feeds; threads 4 to 56 per inch.

Write for complete specifications

ROCKFORD TOOL COMPANY, Harrison Avenue and Eleventh St. **Rockford, Illinois**



ATTENTION

GAP LATHES for SHIP YARD WORK

20/26' x 8'

Swings over V's	. . .	21 inches
Swings over Gap	. . .	27 inches
Width of Gap	. . .	14 inches

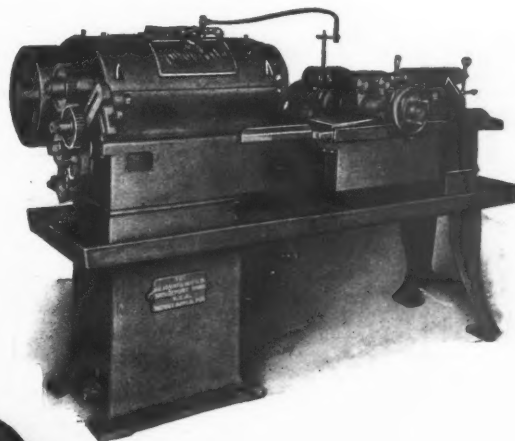
THREE STEP CONE DOUBLE BACK GEAR QUICK CHANGE GEAR

THE RAHN-LARMON COMPANY, Cincinnati, Ohio, U.S.A.

What Threads or Worms Do You Cut?

The Automatic Threading Lathe does not compete with dies or thread millers in their range of work. Rather, it out-classes both, handling that fine, exact work—threads of every character, particularly those of large diameter—that can be cut satisfactorily only on a lathe.

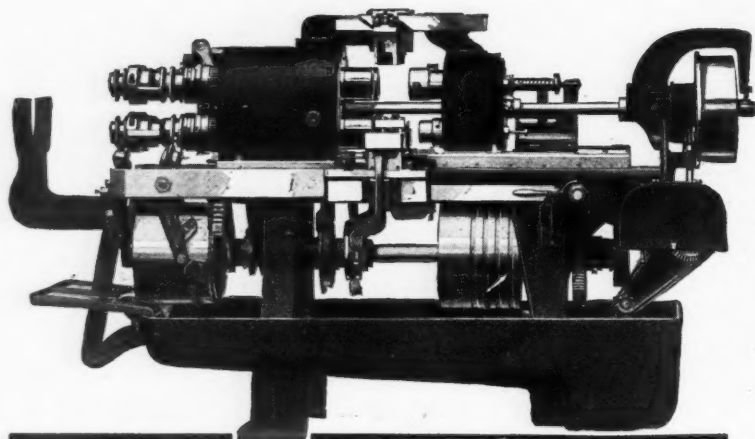
It triples output and lowers costs because it does automatically what must be done by the operator on any engine lathe, and one man can attend a battery.



Information?

AUTOMATIC MACHINE COMPANY, Bridgeport, Conn.

AGENTS: Burton, Griffiths & Co., Ltd., of London, England. Marshall & Huschart Machinery Co. of Chicago, Ill. Motch & Merryweather Machinery Co. of Cleveland, O., and Vandyck Churchill Co. of New York.



THE NATIONAL ACME COMPANY CLEVELAND, OHIO

NEW ENGLAND PLANT, WINDSOR, VERMONT
CANADIAN PLANT, MONTREAL, P. Q.

BRANCH OFFICES—NEW YORK BOSTON CHICAGO DETROIT
ATLANTA SAN FRANCISCO. REPRESENTATIVES IN FOREIGN COUNTRIES

Makers of Gridley Single and Multiple Spindle Automatics at Windsor, Vermont; and
Acme Automatics, Threading Dies, and Screw Machine Products at Cleveland, Ohio

Meeting Requirements

Users of screw machines are putting more and more stress upon Production and the Accuracy of it.

Today there are many manufacturers of screw products who look to Acme Automatics for an output that will meet their requirements.

Eight regular tool positions permit distributing heavy cuts over two or three tools.

All the tools at once gives a constant output at the rate of one piece in the time of a single operation.

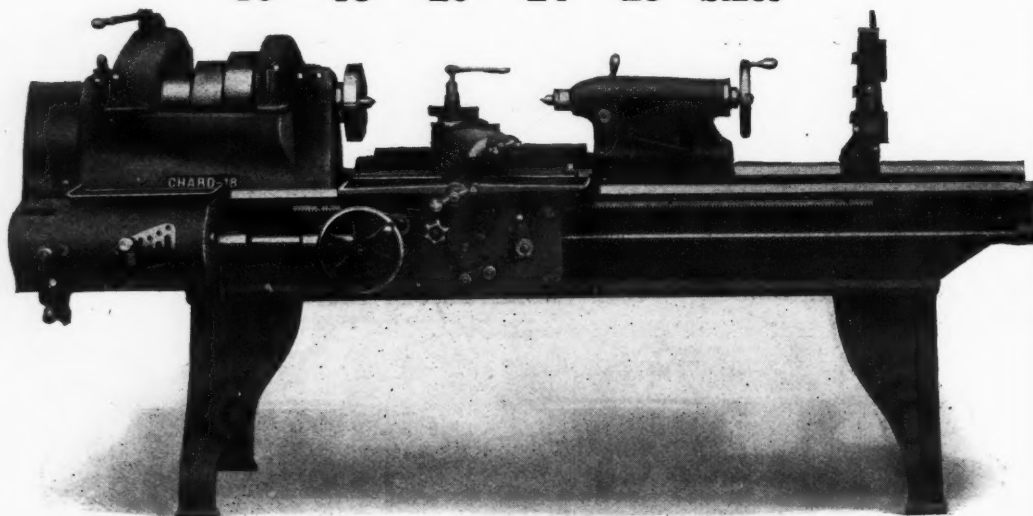
The Acme patented shaving tool insures better finish and uniformity of output.

There's an Acme for every kind of screw cutting work up to $3\frac{3}{4}$ " diameter.

Catalog Acme Method "B"?

The Chard Exceptional Lathe Value

16"—18"—20"—24"—28" Sizes



A Chard Lathe is 100 per cent quality. For an example of its thoroughness of construction, study the value put into the spindle. This is made of a special analysis steel, machined from forgings which are hammered down from 6-inch billets. The steel is thoroughly annealed, reheated to between 1525 degrees and 1550 degrees F., quenched, then reannealed at a temperature of from 1225 to 1250 degrees F. Every detail of construction is just as highly specialized—with factors for convenience and safety worked out to a perfect balance.

Write for complete description

CHARD LATHE COMPANY, Newcastle, Ind., U.S.A.

AGENTS: Vonnegut Machinery Co., Indianapolis, Ind. English and Miller Machinery Co., Detroit, Mich. The W. M. Pattison Supply Co., Cleveland, Ohio. Hill, Clarke & Co., Chicago, Ill. Odgen R. Adams, Rochester, N. Y. The F. O. Stallman Supply Co., San Francisco, Cal. J. S. Miller Machinery Company, Pittsburgh, Pa. Monarch Machinery Company, Philadelphia, Pa. Patterson Tool & Supply Company, Dayton, Ohio.

BICKETT EFFICIENCY

If you have a BICKETT MILLER in your factory you know it is always in use.

If you have not as yet bought one you are minus a good tool.

Not CHEAP, but ECONOMICAL.

Not EXPENSIVE, but EFFICIENT.

Fifteen different styles and sizes, both horizontal and vertical.

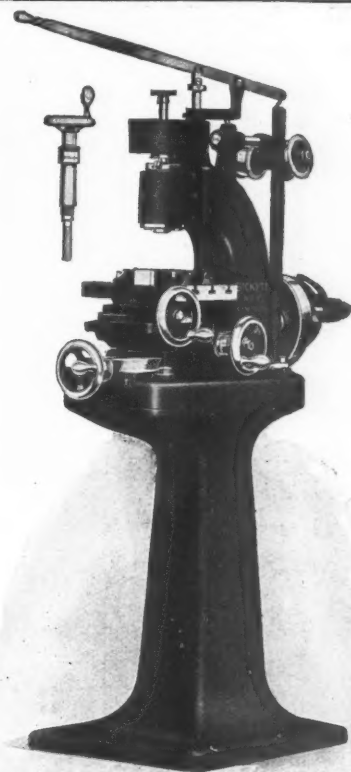
This illustration shows

The BICKETT No. 0 Vertical Milling and Profiling Machine

with spring lever attachment.

Particularly useful for profiling, routing, and letter cutting.

This machine can also be furnished with foot treadle attachment.



THE BICKETT MACHINE & MFG. COMPANY

1118 Richmond Street

CINCINNATI, OHIO, U. S. A.

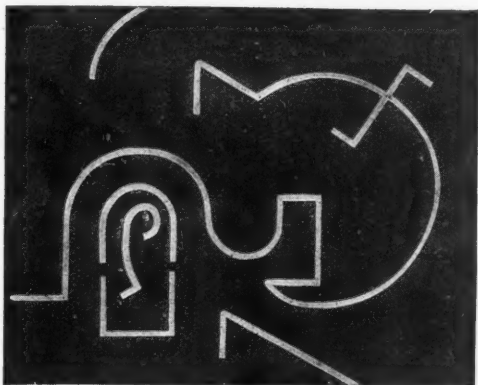
EUROPEAN AGENTS: The Selson Engineering Co., 83-85 Queen Victoria St., London, England.

Gray's Sheet Metal Cutter Saves a Lot of Metal

Steel is high and going higher—so is your scrap heap unless you are using a Gray Metal Cutting Machine for cutting gauge blanks, templates, gaskets, gear covers, jigs, etc.

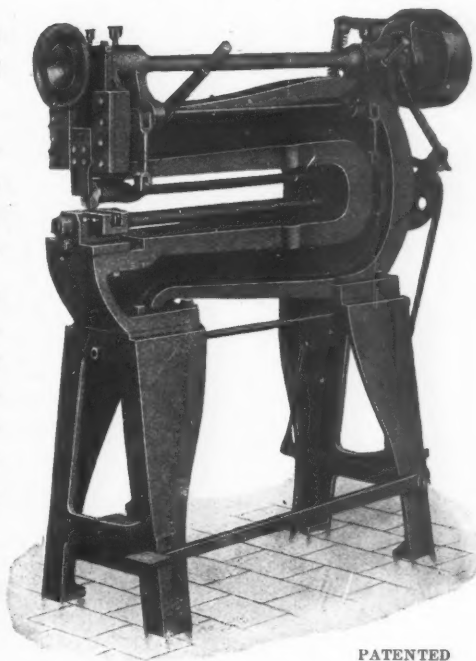
Designs may be laid out close together on a large sheet—conserving every ounce of metal. The Gray Machine cuts a clean, smooth, accurate slot—without the spring and buckled edges of the shearing cut. This is double economy.

Capacity includes metal $\frac{3}{16}$ inch thick in which 30 inches a minute can be accurately cut—the stock is automatically fed in by rollers above and below while the operator follows the design and controls the cutter.



Steel Plate, 10" x 18", $\frac{3}{16}$ " thick, finished by the Gray in 10½ minutes.

Complete description
in Bulletin. Write
for it.



PATENTED

W. J. SAVAGE COMPANY, Inc.
KNOXVILLE TENN., U. S. A.

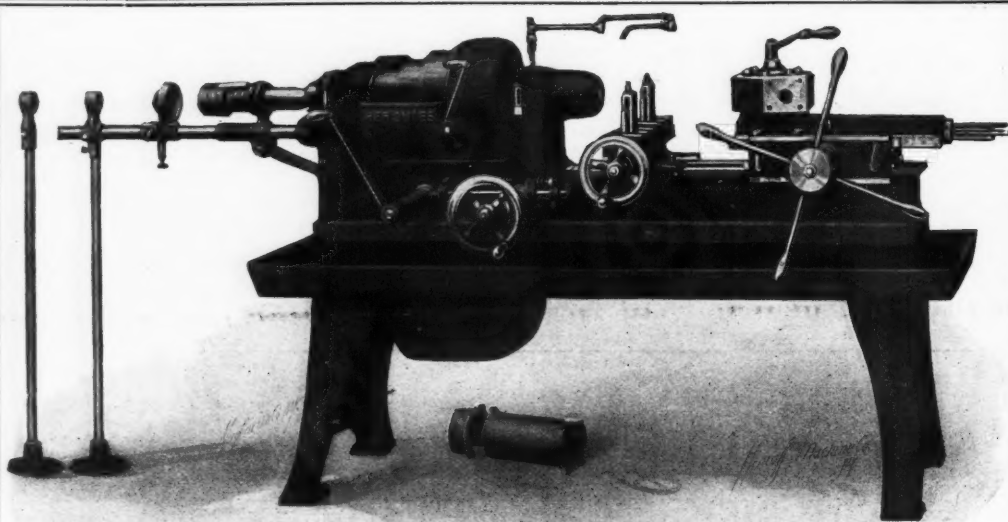
Hercules Turret Lathe AND Screw Machine

*Glad to Send
Detailed
Description
on Request.*

Himoff Machine Co.

45 Mills St., ASTORIA
In the City of New York

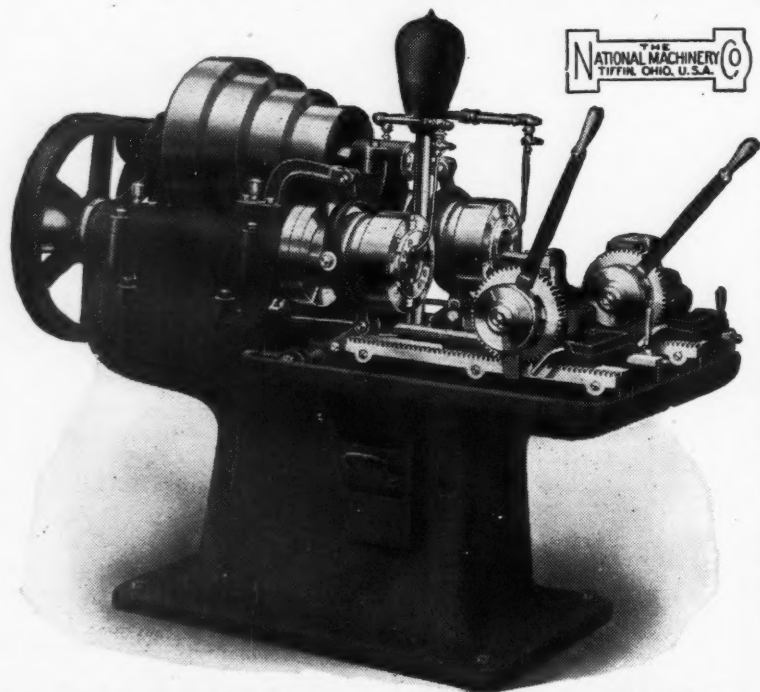
Sales Office:
50 Church St., New York



THIS machine is designed for working bar stock, for producing work that requires turning and threading at one setting, and for machining castings, forgings and second operation work. It is strong and rigid; bed is well braced; head and bed in one-piece; bearings all of phosphor bronze and lubricated automatically by a chain-oiling system. Machine is regularly equipped with automatic chuck and bar feed; but can be furnished without these attachments if desired. It is an accurate worker, operates smoothly, has provision for taking up wear.

A National Bolt Cutter

For Good Threads and Big Productions



About 70 per cent of all screw threads are cut on Bolt Cutters and a large percentage of this production is turned out by "Nationals." No matter what the threading problem, there is a "National" to meet it, which will give you accurate threads, along with the largest possible production.

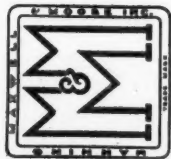
The National Die Head has a positive lock which makes it as rigid as a solid die, and insures absolute accuracy in threading. This accuracy continues throughout the life of the machine, as there is no friction or wear that can affect the threading.

The National Die Head is simple, hence easy to adjust and operate; and can be run at the highest cutting speeds.

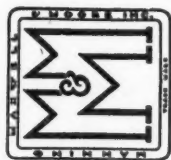
*Tell us your threading problems and
let us give you our recommendation.*

THE NATIONAL MACHINERY CO., Tiffin, Ohio

Originators of Modern Bolt, Nut and Forging Machinery



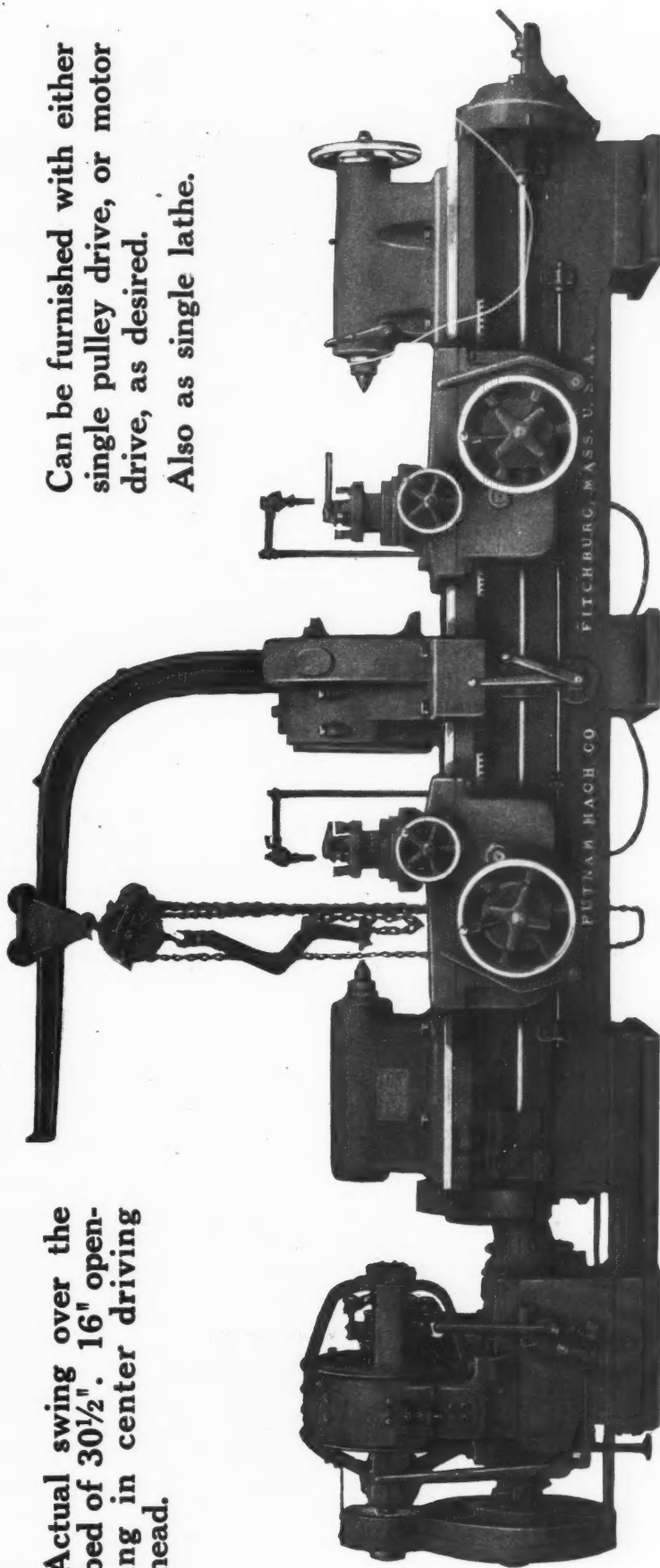
Putnam Heavy Double Axle Lathe



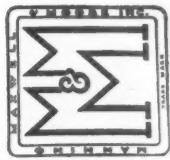
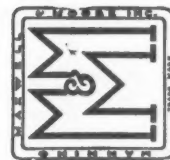
Built for maximum duty, and proportioned throughout to successfully absorb all strains and vibrations incident to heavy cutting.

Actual swing over the bed of 30½". 16" opening in center driving head.

Can be furnished with either single pulley drive, or motor drive, as desired.
Also as single lathe.

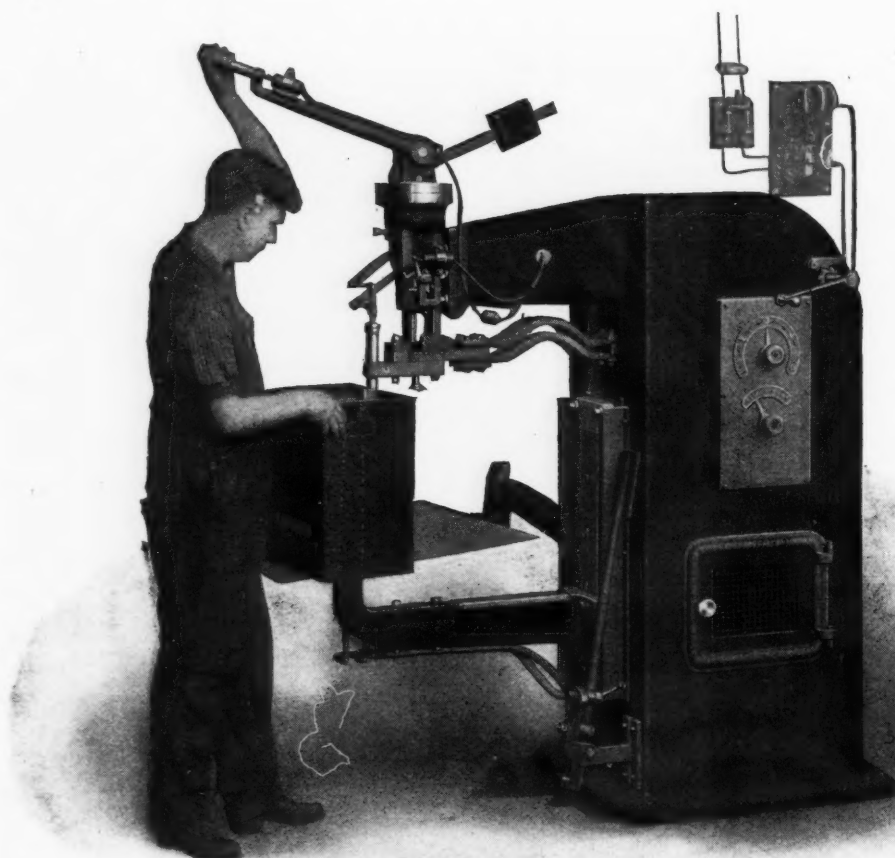


Machine Shop and Foundry Equipment of Every Description.



MANNING, MAXWELL & MOORE, Inc., 119 West 40th Street, NEW YORK

BOSTON BUFFALO CHICAGO CINCINNATI CLEVELAND DETROIT MILWAUKEE
NEW HAVEN PHILADELPHIA PITTSBURGH SEATTLE ST. LOUIS SAN FRANCISCO YOKOHAMA, JAPAN



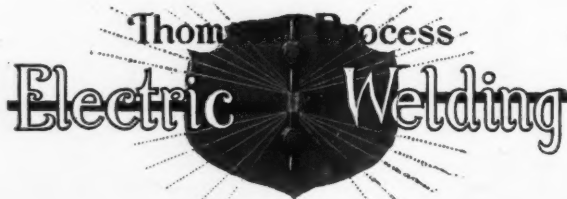
Reduce Riveting Costs 60 to 90%

How? By Spot Welding

One boy and a Thomson Spot Welding Machine can do as much work as five men by the old fashioned method. In spot welding there are no holes to punch, no rivets used, and the result is a stronger and better finished job. Thomson Spot Welders in operation show a saving of from 60 to 90 per cent. Send us samples of your work. We will weld them and return them with figures of surprisingly high speed and low cost.

*If you are riveting work that should
be welded you're wasting good money*

**Write
Us**



**Ask for
Bulletin
S-2**

THOMSON SPOT WELDER CO.

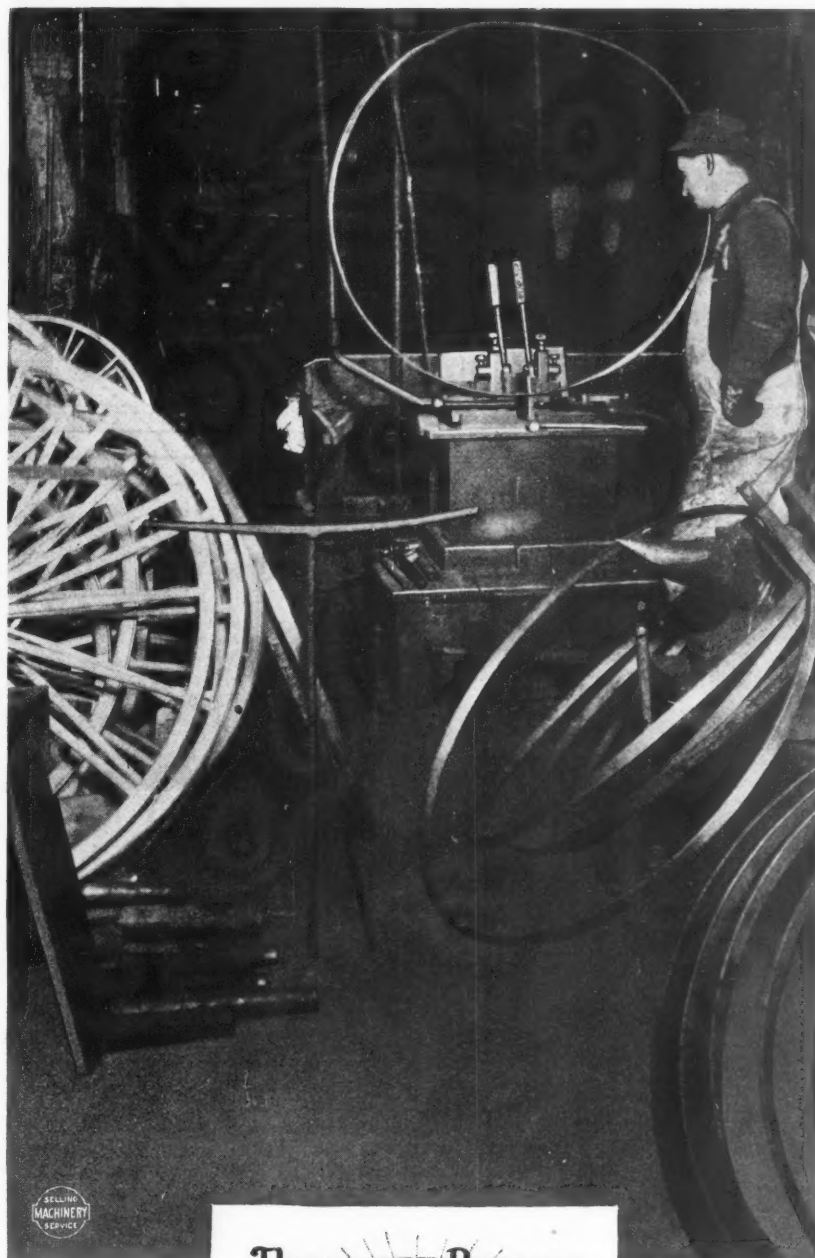
84 State St., Boston

30 E. 42nd St. New York City

603 Finance Bldg. Phila.

The Proper Way to Weld Tires

The proper way, according to the Martin Carriage Works operators, at York, Pa., is the Thomson way. For eighteen years this Thomson Electric Welding Machine has been welding carriage tires. Two minutes per tire completes the job. All the operator does is clamp the work in the welder, bring the ends together and turn on the current. Output has ranged from 15,000 to 18,000 tires per year. The Martin people are going into automobile work, which means just a change of line for the Thomson, since Thomson Electric Welders have made some of their best records in the automobile industry.



Thomson Process
Electric Welding

The important point is that no matter where Thomson Welders work, or how hard they work, they wear well. They are long service machines, high-grade to the smallest detail. We'll be glad to show you before-and-after production figures from concerns now welding with Thomson machines—we'd rather show Thomson advantages on your own product, however. No charge or obligation for demonstration. *Ask for particulars and Bulletin B-2.*

THOMSON ELECTRIC WELDING CO.

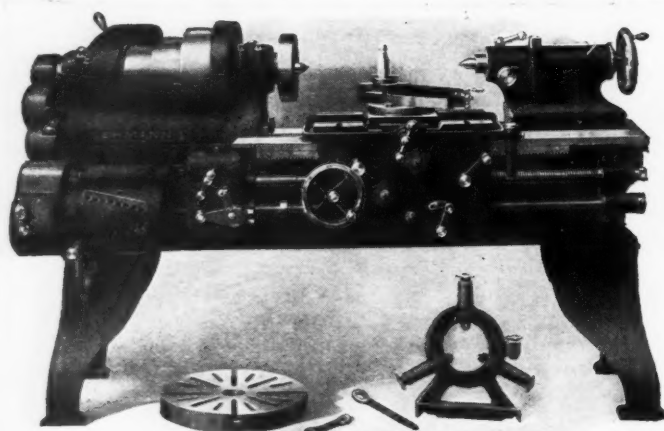
MASS., U.S.A.

311 Falls St. Niagara Falls

4100 Langdon St. Cincinnati, O.

1127 Majestic Bldg. Detroit

323 N. Sheldon St. Chicago, Ill.



16" Lehmann Lathe Swings 18 $\frac{1}{4}$ "

Built for Heavy Duty and Accuracy

3-STEP CONE for 3" belt, DOUBLE BACK GEARS, CHILLED BED, HIGH CARBON STEEL SPINDLE, PHOSPHOR BRONZE BEARINGS, DOUBLE PLATE APRON, STEEL GEARING, BALL THRUST BEARING for lead screw, cuts threads 2 to 112 to the inch without change of gears, GEARED FEEDS from .007 to .4. 9' bed takes 5' between centers, net weight 3020 lbs.

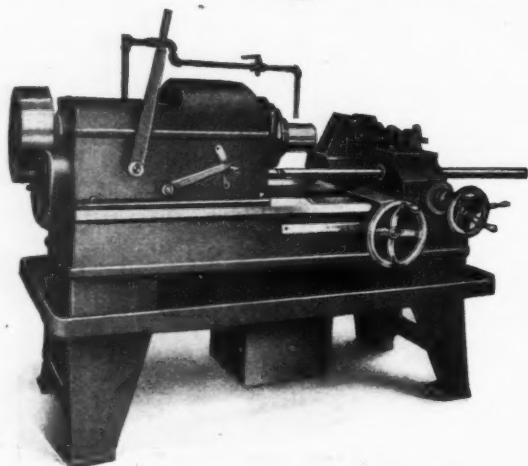
Write for circular illustrating NEW and INTERESTING FEATURES of these lathes.

LEHMANN MACHINE CO.

606 to 612 South Broadway

ST. LOUIS, MO.

Thurlow Waving and Undercutting Machine



Designed to cut, groove, undercut and wave shells simultaneously and at a single operation. Its adoption in any plant never fails to reduce costs and increase production, and in addition, it releases for other operations the lathes now tied up on this work. The Thurlow is made in three sizes to take shells from 3 inches to 9 inches; is strongly built and easy to operate.

Full details on request.

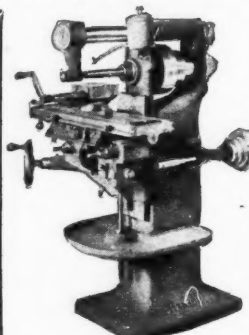
Thurlow Steel Works, Inc.

1418 Walnut St.

PHILADELPHIA, PA.

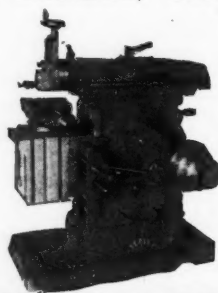
STEPTOE Milling Machines and Shapers

Set Free Your Large Millers and Planers for Heavier Work



John Steptoe Co.

Brighton
Cincinnati, Ohio



Steptoe Milling Machines and Shapers will enable you to get economy and efficiency in production by the proper distribution of work.

The best possible evidence of their reliability, accuracy and economy is the fact that thousands of them are in world-wide use to-day.

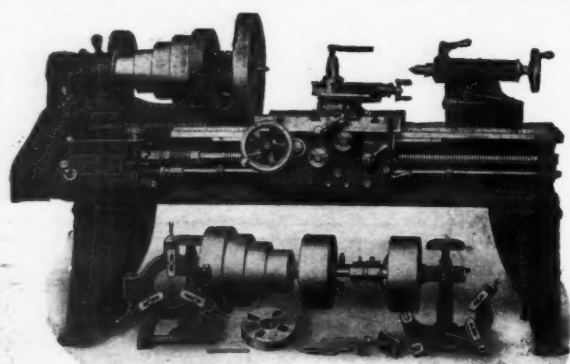
Champion Lathes

Built to Turn Out Accurate Work Fast

Champion Lathes are solidly constructed 12-, 14-, 16- and 18-inch machines. Metal is distributed to give each machine maximum rigidity and strength; power is provided to handle heaviest cuts within range; convenient arrangement of operating parts assures speed. The "Champion" is an A-1 tool room or manufacturing lathe. General Catalog on request.

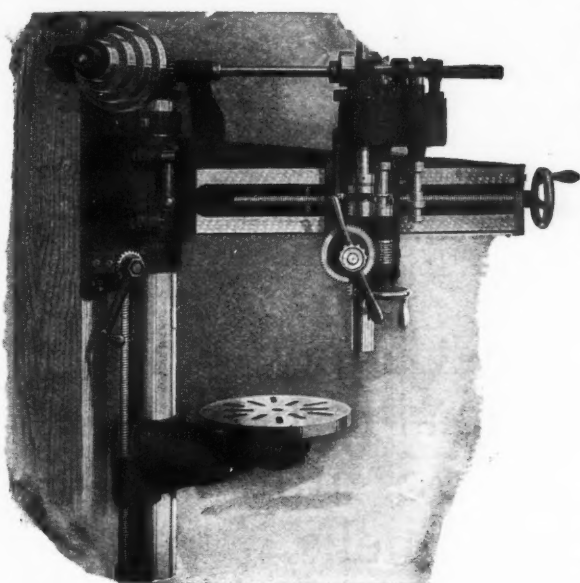
CHAMPION TOOL WORKS CO.

2422 SPRING GROVE AVE., CINCINNATI, OHIO, U. S. A.



Canedy-Otto Wall Type Radial No. 51

Every Shop Needs It—Every Shop Owner Can Afford It



For the garage, the machine shop or other plant where a low cost "Radial" is needed. Adapted for a wide range of work, absolutely reliable in every respect. Equipped with automatic cut-off, four instantaneous speed changes, and quick return lever serving as pilot to move spindle. Well built throughout, rapid, accurate. Furnished with 2½ or 3½ foot arms, drills up to 1¼".

PRICES

No. 51—2½ Foot Arm . . \$237.50 Net

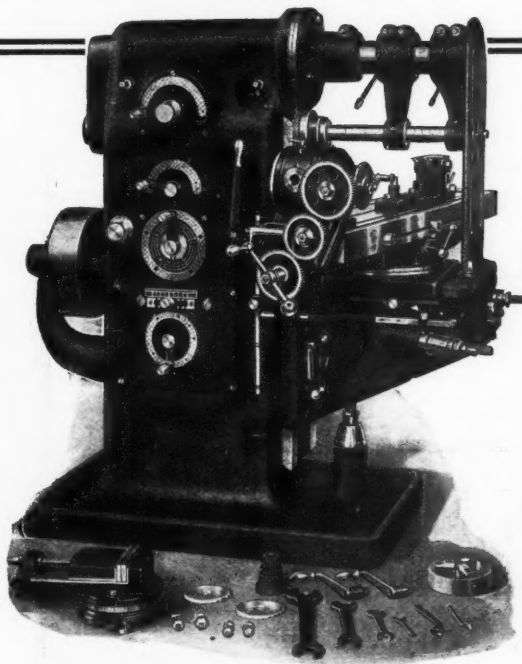
No. 51—3½ Foot Arm . . \$250.00 Net

F. O. B. Chicago Heights

Carried in stock by leading jobbers and machinery dealers everywhere. Ask for circular and name of our dealer in your locality.

CANEDY-OTTO MANUFACTURING CO.
CHICAGO HEIGHTS, ILL.

The Rockford No. 2 is a Well Balanced Machine



Extra reinforcement at every point of strain, arm braced to withstand vibration, and smoothly running mechanism insure the uniform, powerful service which only a well balanced machine can give.

Fourteen changes of feed, eighteen speed changes—ranging from 13 to 350 R. P. M.—and simple, instant control with accurate adjustment, equip the "Rockford" to handle any piece of work its ample table will accommodate.

These twin qualities, perfect balance and sturdy rigidity, make it possible for the NO. 2 ROCKFORD MILLING MACHINE to take heavier cuts without chatter than any similar machine of its size.

Complete specifications on request.

ROCKFORD MILLING MACHINE CO., Rockford, Illinois

IMMEDIATE DELIVERY

From Stock

Complete Line Calipers and
Gauges and Official Inspecting
Apparatus for 75 mm and
155 mm Shells

Including Shells, Cases, Sockets,
Fuses, Etc.

Stamped with the Approval of the
French Technical Artillery Section

Also Full Stock
Caliper Gauges, and Thread Gauges
for

Aviation Motors

Hispano-Suiza — Clerget — Rhone — Gnome

LA PRECISION MECANIQUE

11, Rue Vergniaud

PARIS, FRANCE

Manufacturer of Caliper Gauges—Established 1912

Telegraphic Address: CALIBRE, PARIS

Complicated Die Castings BEST MADE BY Stewart Process

Complicated and intricate parts require superior facilities, skillful designing of dies, and a vastly superior degree of technical and mechanical ingenuity to insure satisfactory die-castings.

The Stewart staff of engineers, die-makers, metallurgists and machine operators have had years of experience in the production of the most complicated parts ever designed.

That is why Stewart Process die-castings are acknowledged to be representative of the highest standard in die-casting engineering.

The Stewart Process is the solution of your die-casting problems.

STEWART MFG. COMPANY
Wells St. Bridge CHICAGO





Bunting's Bronze Bushings and Bearings

"Selling" the purchasing agents of million-dollar corporations is a man-size job. These gentlemen know a "good buy" when they see one, but you have to show them every inch of the way. Good salesmanship is not enough—a good product must back it up.

The fact that 51 concerns rated at \$1,000,000 and over, in addition to 175 more rated at from \$200,000 to \$1,000,000, order Bunting's Bronze Bushings and Bearings is sound evidence of a thoroughly satisfactory product. If million-dollar corporations, with their complete and modern equipment, find it more profitable to buy bushings and bearings completely machined and ready for assembly there's something worth while for *you* in Bunting's service. They find it cheaper and better or they would not buy. Think that over and send for price list G.

THE BUNTING BRASS & BRONZE CO.

**748 SPENCER STREET
TOLEDO, OHIO**



STELLITE



ARC WELDED TOOLS

**A Stellite Arc
Welded Tool Turns a
Remarkable Chip**



To let you judge
Stellite's quality, two
samples, one for cast
iron turning, one for
steel, will be sent you
upon receipt of \$1.00.

Jobs like the one that produced this chip throw Stellite superiority into bold relief. The chip was turned off a 1½" bar of 50 carbon steel by a Stellite Arc Welded Tool at such a high turning speed and with such a coarse feed that the end of the chip was fused, and the floor was scorched where the chip dropped upon it. Stellite "stacks" up against some mighty tough turning propositions, but the harder they are the greater are Stellite advantages. Any steel tool will stand the ordinary job; but it takes Stellite for the "heart-breakers."

We'll gladly tell you all about it, if you'll write.

THE HAYNES STELLITE COMPANY

HOME OFFICE AND PLANT

Patentees and Sole Manufacturers

KOKOMO, INDIANA, U. S. A.

BRANCH OFFICES:

1829 Lytton Bldg., Chicago, Ill.
2402 Union Central Bldg., Cincinnati, O.
1370 Penobscot Bldg., Detroit, Mich.

120 Broadway, New York City, N. Y.
517 Rockefeller Bldg., Cleveland, O.
523 Widener Bldg., Philadelphia, Pa.

2220 Farmers' Bank Bldg., Pittsburgh, Pa.

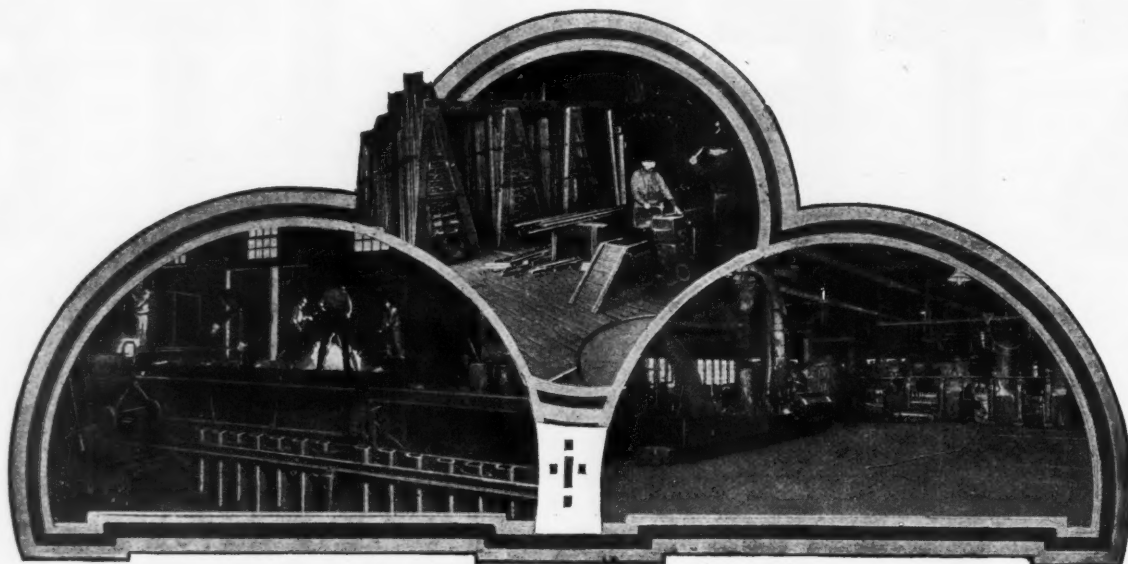
also sold by

THE MIDVALE STEEL COMPANY

OFFICES: Philadelphia, Boston, New York, Cleveland, Chicago, San Francisco.

Licensed Canadian Manufacturer

DELORE SMELTING AND REFINING COMPANY
Deloro and Montreal, Canada.



Why WOLFRAM is a Standard Tungsten High Speed Steel

Wolfram is Heat Resisting

Carbon Steel without Tungsten will harden at 1400 degrees F. and will coarsen at 1500 degrees F. The same steel containing 18 per cent Tungsten will not coarsen even at 2350 degrees F.

Tungsten is the only alloy of which as high as 18 per cent may be used beneficially in tool steel, and the heat resisting power of the steel is increased in proportion to the Tungsten contained.

Wolfram is Uniform

The nature of the alloying element must be such that the commercial product will be uniform and reliable. One heat must be very similar to another, one bar to another, and each bar must be the same throughout its entirety.

Wolfram is Unchanging

Again, the steel must stand the test of time. It must stand repeated redressing, hardening and use, without breakage or loss of cutting power. And *TUNGSTEN is the most stable alloy.*

WOLFRAM is of uniform high quality, and may be worked down to the last ounce without variation.

VULCAN CRUCIBLE STEEL COMPANY

ALIQUIPPA

ESTABLISHED 1900

PA., U. S. A.

BRANCHES:

BOSTON.....102 Purchase Street
CHICAGO.....16-18 So. Clinton Street
DETROIT.....310 New Telegraph Bldg.

MONTREAL.....Herald Bldg.
NEWARK, N. J.....52 No. 11th Street
ST. LOUIS.....1215 International Life Bldg.



The "Rocker-Joint"
Depends Upon Its Construction,
not Upon Lubricant,
for Its Life and Efficiency

POWER TRANSMISSION

What does she know about it? Not a thing! But she knows that he knows, and that's the point. He is a long-time user of silent chains and what he says about them counts.

This is what he says: "There is *only one silent Chain* with a properly designed joint, and that is the **MORSE**. The 'ROCKER-JOINT,' the exclusive, patented feature of the **MORSE**, eliminates all power losses because it permits *no destructive sliding friction*, as do all other joints. There is only the simple movement of the rocking-chair."

Flexible Positive Efficient

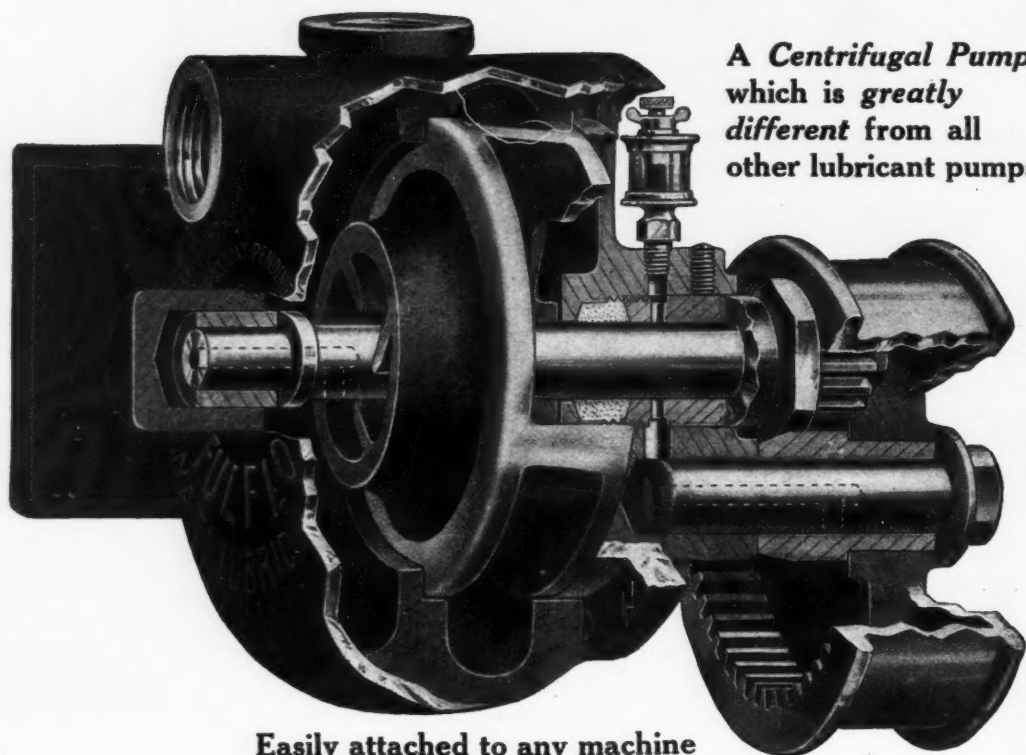
MORSE CHAIN CO., Ithaca, N. Y.
Largest Manufacturers of Silent Chains in the World

MORSE SILENT CHAINS



FULFLO

The Lubricant Pump You've Looked For



A Centrifugal Pump
which is greatly
different from all
other lubricant pumps

Price
\$10.00

Discount
on
Quantities

Easily attached to any machine

THE ONLY LUBRICANT PUMP
FOR WHICH THESE CLAIMS CAN BE TRUTHFULLY MADE

"The Trouble-proof Pump"

1 Greatest Capacity. 50 per cent more volume than any other pump its size. 1 to 20 gallons per minute, according to speed.

2 Cannot Lose Its Prime. Water has to run uphill before the Fulflo can lose its prime. All other pumps depend on valves to hold their prime.

3 Longest Life. There is but one pumping part—the impellor—and it touches nothing but the liquid, therefore retains its pumping efficiency indefinitely.

4 Won't Clog. Anything that can get in will go right through without injury to the pump. No passage smaller than intake, which is $\frac{3}{4}$ inch.

Are you going to continue to put up with lubricant pump troubles which have heretofore been necessary evils, or are you going to improve this feature of your manufacturing methods as you have all others, now that it is possible for you to do so?

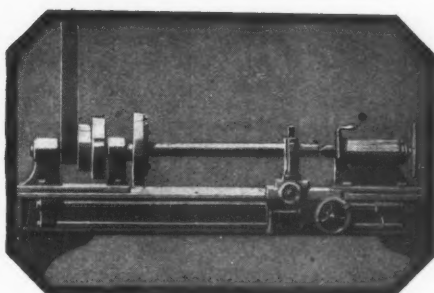
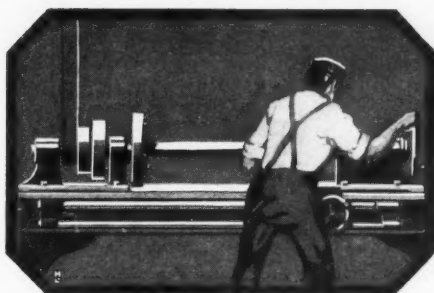


THE FULFLO
PUMP
COMPANY

129 Opera Place
CINCINNATI, OHIO, U.S.A.



The Machine Without a Man



ONE of the chief causes of delay in all forms of manufacturing is the machine without a man—the machine that is momentarily idle.

When a workman has to shut down his lathe to look for the bolt he is to turn, when he has to stop work to sharpen or find his tools, his machine is not producing and a decrease in output results.

Of all the causes which make it necessary for an operative to leave his machine, poor light is the most common—and the most unnecessary.

Even if the window to which a workman must step in order to adjust his micrometer or examine his calipers is but a few feet distant, a certain amount of time is lost. Insignificant as these seconds may seem in each individual instance, the total amount of time wasted by all operatives in similarly unproductive movements is far from negligible.

Every machine in your plant should be so well lighted that no workman need ever step away from it in order

to see more clearly. The lamp that makes it unnecessary for him to walk to the window will soon pay for itself.

Adequate illumination will remove one of the chief causes of delay. It will enable you to speed up production by keeping your machine running all the time, and it will also improve the quality of your output.

By suggesting improvements and alterations to your lighting system our Engineering Department is ready to help you remove the most unnecessary cause of delay. This service is free and obligates you in no way.

"Increasing and Improving Production" is the title of a new book we have just published. The wide experience of the author, Mr. R. T. Kent, in industrial plant operation has enabled him to discuss the problems of factory management from the standpoint of practice rather than theory.

A copy of this book will be sent upon request to any industrial plant manager.

Westinghouse Lamp Company

165 Broadway, New York

Sales Offices and Warehouses Throughout the Country

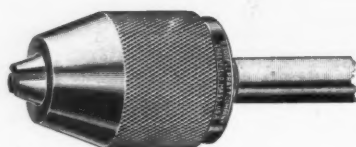


GUARANTEED BY THE NAME

GOODELL PRATT

1500 GOOD TOOLS

IMMEDIATE DELIVERY on Goodell-Pratt and Greenfield Drill Chucks



Goodell-Pratt Drill Chuck
1/2" Inch Round Shank



Goodell-Pratt Drill Chuck
Morse Taper Shank



Goodell-Pratt Drill Chuck
Bit Brace Shank



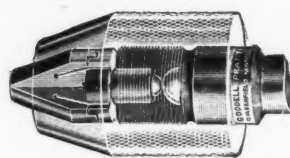
Goodell-Pratt Drill Chuck
Shank Fitting No. 2 Ratchet

At the present time we have in stock, or can assemble within a very short time, all styles and sizes of Goodell-Pratt and Greenfield Drill Chucks.

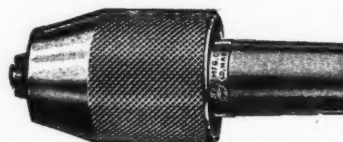
These chucks are made entirely of steel, are very simple in construction, but will be found equal in accuracy and durability to many that are very much more expensive.

We make such extraordinarily large quantities of these chucks for use on our various drilling devices that we are able to sell them at remarkably low prices.

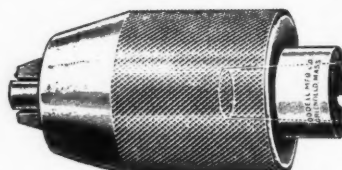
These chucks are regularly made in four different capacities up to 1/2 inch. They can be furnished with 1/2 inch, 41/64 inch, bit brace, or Morse taper and other shanks; or without shanks if desired.



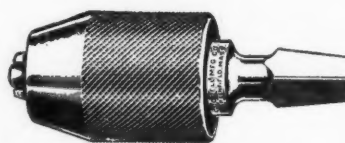
Greenfield Drill Chuck
Sectional View



Greenfield Drill Chuck
Morse Taper Shank



Greenfield Drill Chuck
Taper Hole



Greenfield Drill Chuck
Bit Brace Shank

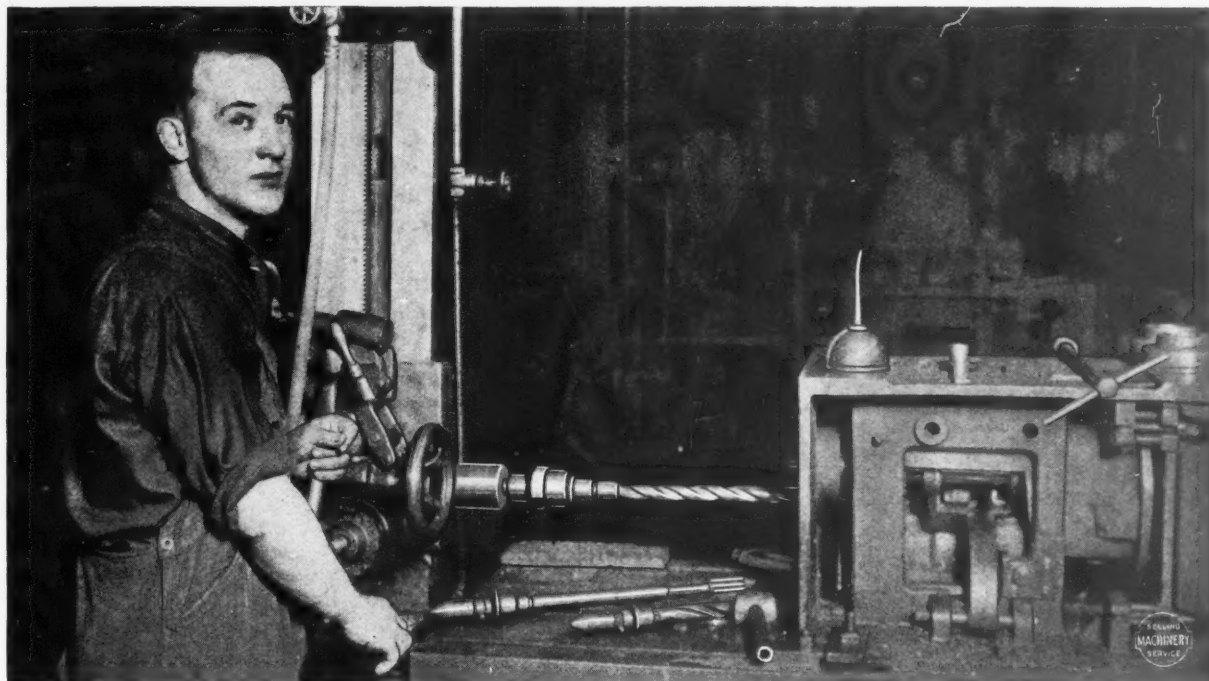
GOODELL - PRATT COMPANY

GREENFIELD

Toolsmiths

MASS., U. S. A.

WIZARD CHUCKS AND COLLETS



Equally Satisfactory on Either Horizontal or Vertical Spindles

At the Morrow Mfg. Co.'s plant, Elmira, N. Y., time is money; every second is made to count. If work calls for boring, drilling, reaming, tapping, etc., whether on boring machines, lathe or drill press, about the first move the operator makes is to reach for his Wizard Chuck and Collets. He can make tool changes with a Wizard outfit *without stopping the spindle*; he lowers non-productive time to the minimum, and incidentally he makes an A-1 record for himself and his machine.

McCrosky
COST CUTTING TOOLS

WIZARD Chucks have a sure grip. They hold big tools in heavy cuts regardless of spindle position. They have been part of the Morrow regular shop equipment for five years. To operate a Wizard Chuck you grasp the chuck in one hand and the tool in the other and the trick is done.

Can you afford to change tools the old fashioned way? Order a "Wizard" on trial and find out.

Write us about it.

THE McCROSKY REAMER CO.

MEADVILLE, PA., U. S. A.

EXPORT AGENT: Benjamin Whittaker, 21 State St., New York, N. Y.
DIRECT REPRESENTATIVES: Young, Corley & Dolan, Inc., 115 Broadway, New York City. J. R. Stone Tool and Supply Co., 24 Goebel Bldg., Detroit, Mich. R. E. Ellis Engineering Co., 549 Washington Blvd., Chicago, Ill.

Quality

ONE-HALF INCH
QUALITY HACK SAWS
NAPIER SAW WORKS, INC.
MADE IN U.S.A.

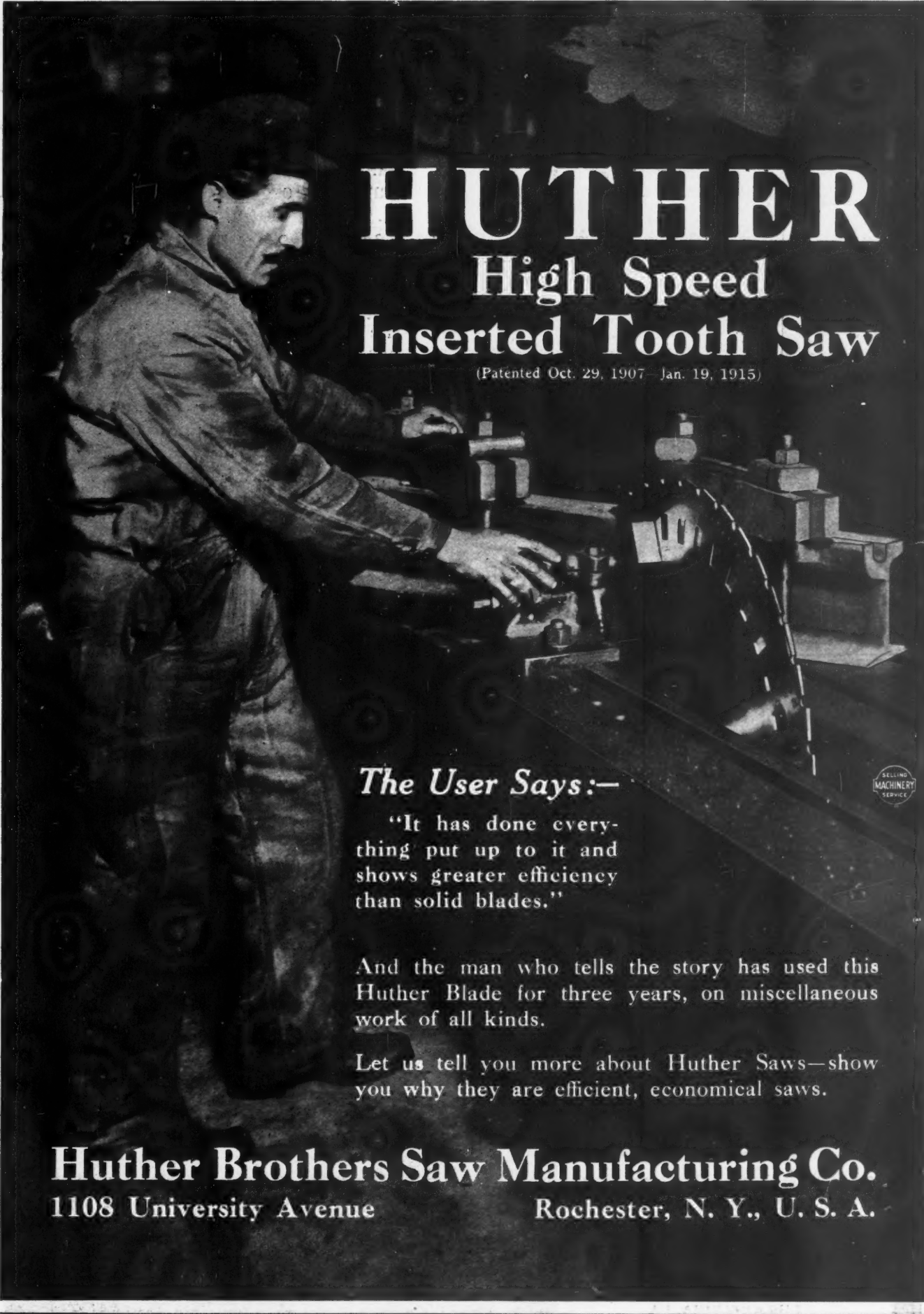
12 x 1 QUALITY

**DURABILITY
and QUALITY**

Are Always Found Together

Send for Catalogue

NAPIER SAW WORKS, Inc.
SPRINGFIELD
MASS.



HUTHER

High Speed Inserted Tooth Saw

(Patented Oct. 29, 1907—Jan. 19, 1915)

The User Says:—

"It has done everything put up to it and shows greater efficiency than solid blades."

And the man who tells the story has used this Huther Blade for three years, on miscellaneous work of all kinds.

Let us tell you more about Huther Saws—show you why they are efficient, economical saws.

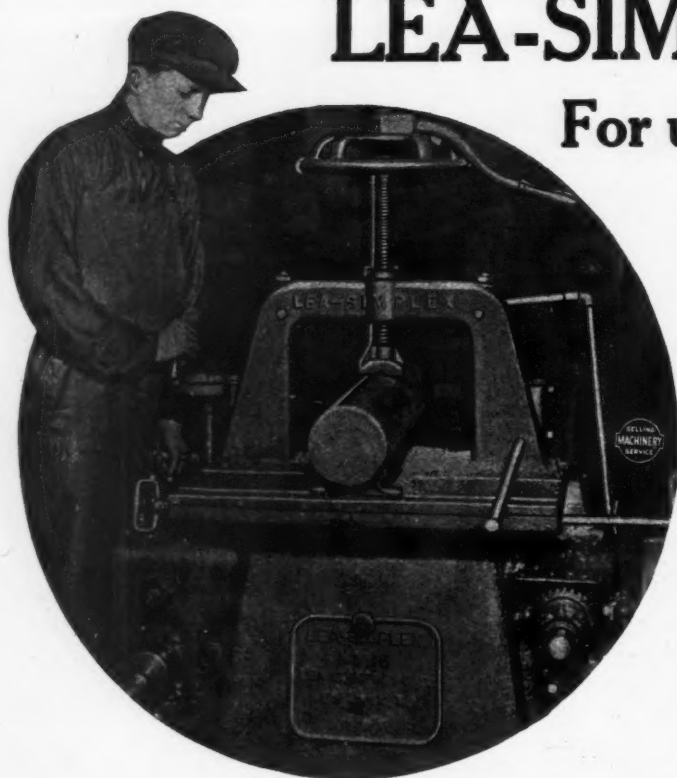
Huther Brothers Saw Manufacturing Co.

1108 University Avenue

Rochester, N. Y., U. S. A.

LEA-SIMPLEX SAWS

For use in the Stock Room



A group of Lea-Simplex Cold Saws, represented by this No. 15 machine, has earned the good word of the Buffalo Forge Company, Buffalo, N. Y. The Buffalo Forge people have worked these machines for eight years—worked them hard—and found them satisfactory in every way. They are still doing most of the stock cutting, and have every appearance of being good for a long busy future.

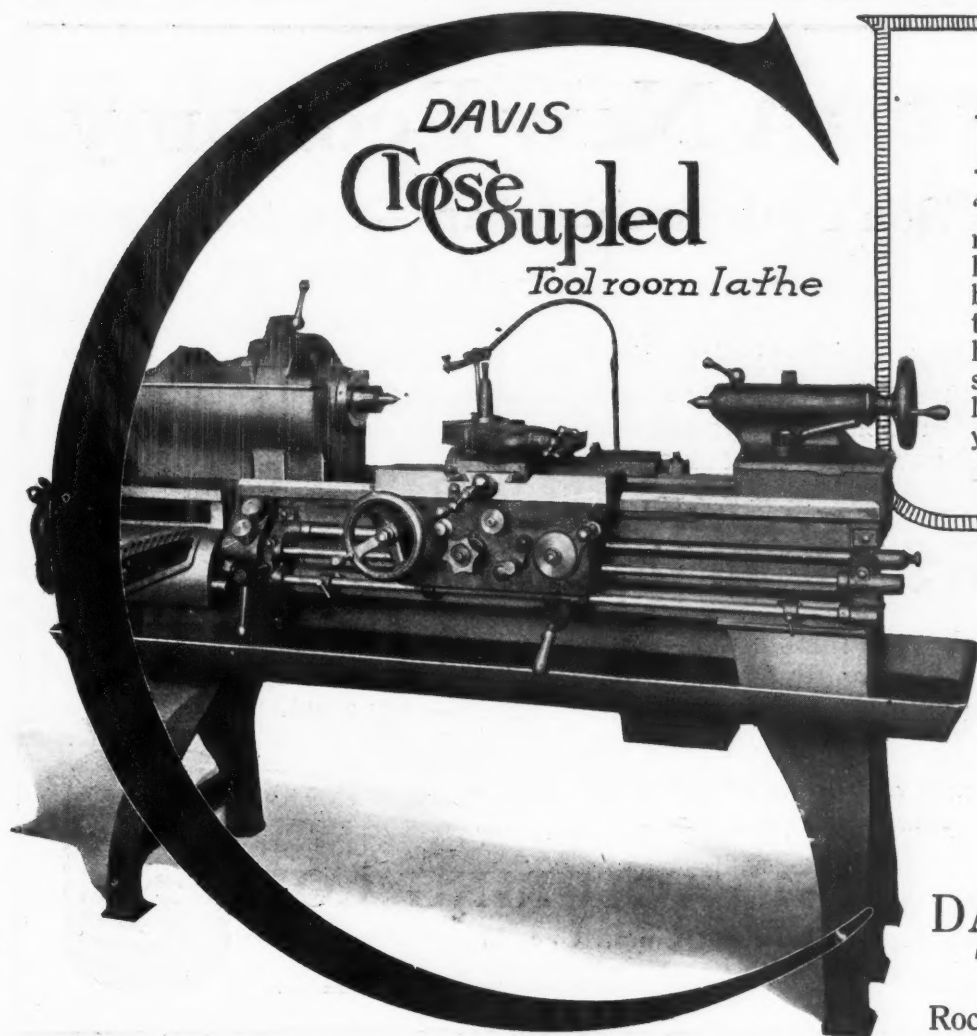
Lea-Simplex Cold Saws are simple, powerful, dependable machines with special reasons—the sprocket drive, for one—for remarkable performance. *Write for particulars.*

EARLE GEAR & MACHINE COMPANY

4705 STENTON AVENUE

PHILADELPHIA, PA.

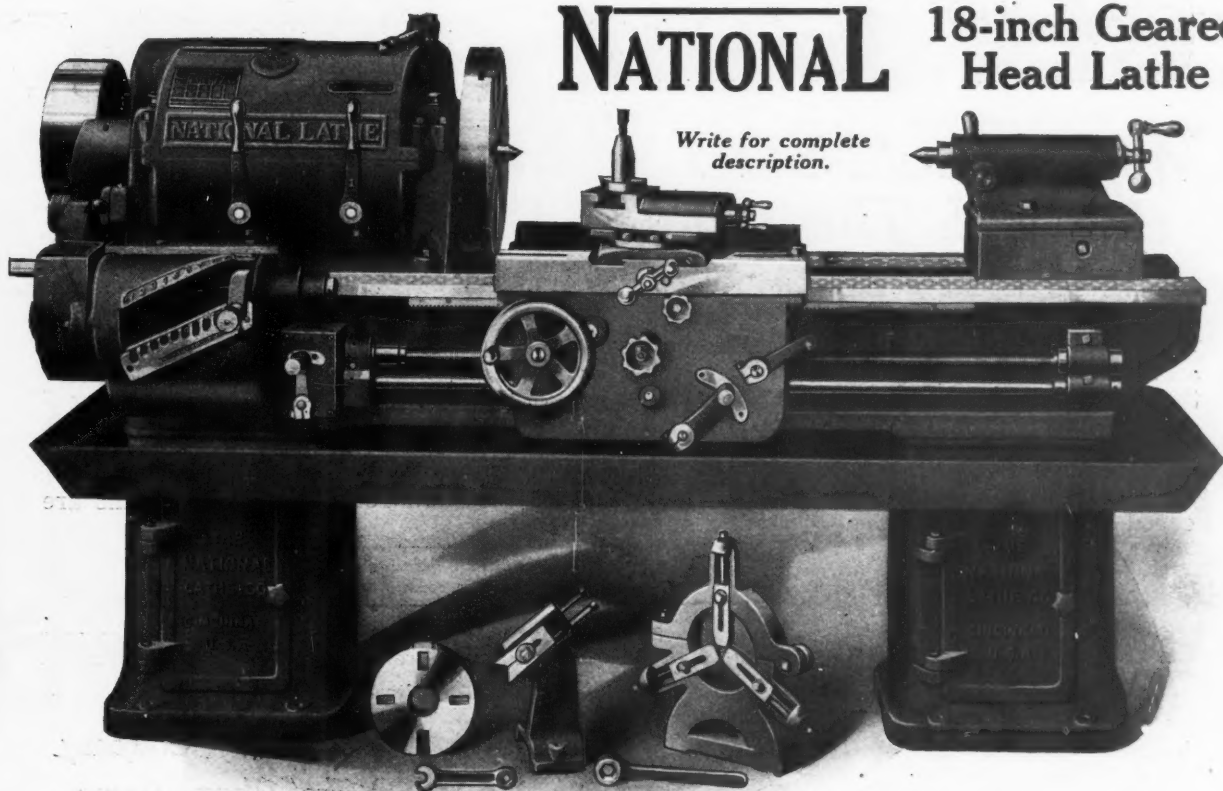
50" Disston Interlocking Inserted Tooth Metal Cutting Saw
 In the
AMERICAN LOCOMOTIVE CO. PLANT
 Schenectady, N. Y.
*Teeth inserted on dovetail principle
 and firm against heaviest pressure*
HENRY DISSTON & SONS, Inc.
 PHILADELPHIA, PA.



MODERN demands have been fully met in our new "Close Coupled" tool room lathe. The spindle has taper bearings, and ball thrust. Add to these features generous housings, and 14¼" swing, and you have a lathe worthy of place in your tool room.

Complete description will be sent on request.

**DAVIS MACHINE
TOOL CO., Inc.**
Rochester, N. Y. U. S. A.



NATIONAL

**18-inch Geared
Head Lathe**

*Write for complete
description.*

THE NATIONAL LATHE COMPANY
Established 1912

15 West Second St., Cincinnati, Ohio, U. S. A.



A New Economy



Don't Buy Special Taps—



Extend Those on Hand

Allen Patent Tap Extensions eliminate the necessity of keeping taps with extra long shanks on hand, in case you *may* need them—and prevent delay when you *do* need them and have none in your equipment.

Allen's Patent Tap Extensions

used singly or in combination—add from 1½ to 11 inches to the effective length of your taps. Fit the shanks of all standard makes—easily ground to fit others—try a set.

*We also make a full line of Safety Set Screws
Many styles and sizes.*

THE ALLEN MANUFACTURING CO.

135 Sheldon Street, Hartford, Conn., U. S. A.

People's Life Insurance Bldg., Chicago, Illinois

173 Princess Street, Manchester, England



What Would YOU Do With Them?

The natural impulse would be to scrap 'em, but it's our business to show you that would be the very thing *not* to do. We reclaim all such worn reamers and drills; make them over so they are as efficient as new tools. We do it *without annealing*—or even drawing the original temper.

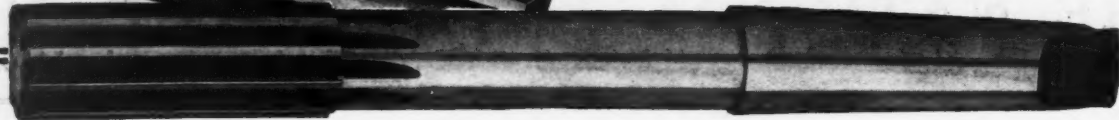
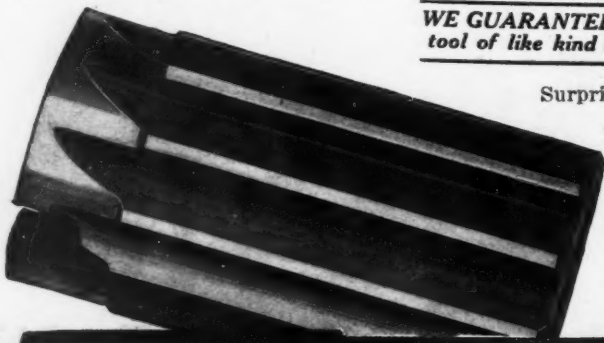
We straighten shanks, square off broken ends, restore centers, renew tangs and tapers, and deepen flutes to give same chip room as new reamers. Scored drills are cured by the same medicine.

WE GUARANTEE every tool we salvage to be equal to any new tool of like kind in accuracy, working qualities and durability.

Surprise yourself by finding out how much you can save by letting us salvage your old drills and reamers.

Write for particulars today.

*Detroit Reamer Salvage Company
818-820 West Warren Avenue
Detroit*

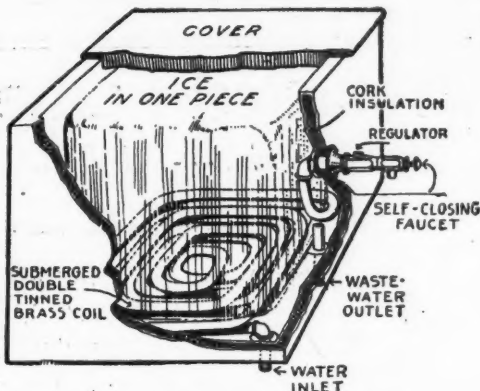


ALLEN INSTANTANEOUS WATER COOLERS

Did you ever notice how much better a man works after he has taken a refreshing drink of water?

Attach to
City Water
Supply

Ice is
Separated
from Water



Sectional View Showing Construction of
Allen Coil Cooler Boxes

"Dog Days" are coming but that's no reason why your workmen should lead a "dog's life" through this sweltering season. Give them plenty of good, cool water to drink, make them comfortable as possible, and production will not suffer. Allen Water Coolers do the trick. Stock sizes for 25, 50, 100 or 200 pounds of ice, fitted with self-closing faucets or bubblers, sanitary and economical.



Style B

Notice—Ice Goes in
In One Piece—Lasts Longer

Our list of satisfied users includes many plants of national reputation, such as:

Studebaker Corporation,
Peerless Motor Car Co.,
Chalmers Motor Co.,
Wrigley Chewing Gum Co.,
Glidden Varnish Co.,
Western Union Telegraph Co.,
Curtiss Aeroplane Co.,
Cleveland Automatic Machine Co.,
Chevrolet Motor Co.,
Carborundum Co.,
Kelsey Wheel Co.,
Standard Motor Construction Co.,
Remington Co.,
King Motor Co.,
John A. Roebling Sons Co.,
Electric Auto-Lite Co.,
Crocker-Wheeler Co.,
Hudson Motor Car Co.

Write for folder on
"Drinking Water Coolers that
Save Money."

**The Allen Filter
Company**

TOLEDO, OHIO, U.S.A.



**A
Straight
Tip**

The Athol Vise is a Dependable Vise

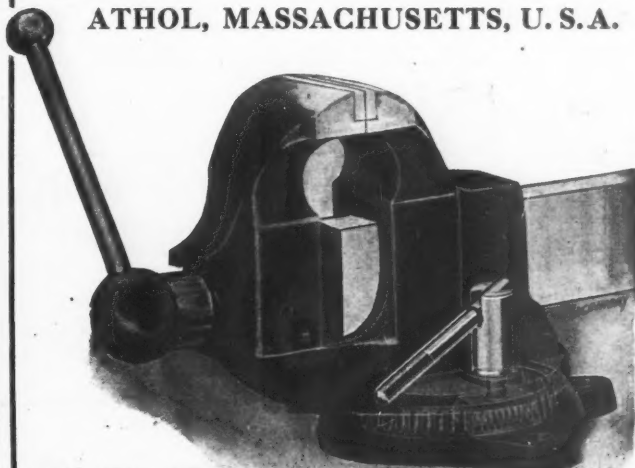
"Now it swivels and now it don't. Swing it round till you have it at just the handy angle, push down the lever—and get to work. The base is as solid as bed rock and will stay so until you release the bull-dog grip of the Starrett locking device. Don't forget to disengage the handle and drop it down out of the way. Your work can't slip, the buttress thread on the vise screw was specially designed to hold it—and the Athol hold is some grip."

A convenient, dependable vise is an important asset in a shop that does particular work.

*Send for complete description
and catalog of our machinery
and high-grade tools.*

ATHOL MACHINE COMPANY

ATHOL, MASSACHUSETTS, U.S.A.





O. K. TAPS AND DIES For Long and Faithful Service

Hammered from flat bar steel, specially heat treated, given ample chip clearance and means for lubrication, O. K. Taps and Dies are well adapted to survive a long period of active duty.

Accuracy and durability are standards that are never lost sight of in the manufacture of these tools. They are twin qualities that can be reckoned on by every user.

Complete list in Catalog 7A.

F.E. WELLS & SON COMPANY
GREENFIELD, MASSACHUSETTS



"Matthews" Helps with the Pay-Roll

The bother and expense of time checking and pay-roll distribution can be cut down considerably by the use of

Matthews' Identification Checks and Badges

They are clean-cut, easily read, not easily duplicated, and will last a life-time. Unusually prompt delivery on most styles.

*Book of Checks, Badges and
Name Plates on request*

**Jas. H. Matthews
& Company**

Manufacturers of Mark-
ing Devices Since 1850.

3946 Forbes Field
PITTSBURGH, PA.



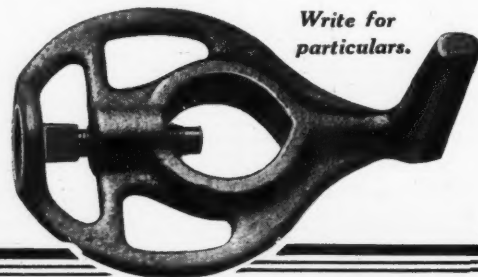
Protected Lathe Dogs SAFE --- RELIABLE



We carry a full stock of standard crucible cast steel, protected lathe dogs—strong, durable, dependable lathe dogs. We are regularly supplying concerns whose policy is to surround their workers with the most reliable safeguards they can find. We shall be glad

to go into the question of lathe dog equipment with you and explain why ours are the better kind.

**Straight or
Bent Tail
Lathe Dogs,
any size,
any form.**



*Write for
particulars.*

The West Steel Casting Co.
CLEVELAND OHIO

You Can Now Solder Aluminum Successfully

Send for
a
Welded
Sample



WITH

So-Luminum
The Aluminum Solder

Makes joints that are stronger than the metal.
No flux required. Used with gasoline torch.

SAMPLE BAR \$1.00

*Used and endorsed by U. S. Army and navy, and leading auto-
mobile and aeroplane manufacturers. Send for booklet 200.*

SO-LUMINUM MFG. CO., 1790 Broadway, New York

Oil Pan Logic

**LATHE PANS
SPLASH
GUARDS
GEAR
GUARDS**

Sheet Steel Oil Pans weigh less, cost less and wear longer than any other kind and fulfill every requirement.

Incorporated when assembling or easily attached to machines already on the floor.

Littleford Sheet Steel Oil Pans

are the logical pans for your equipment.

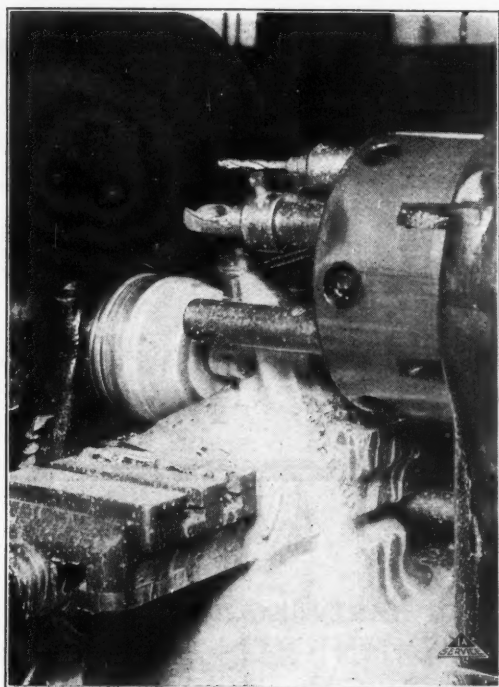
Send for details, prices, etc.



LITTLEFORD BROS.

354 E. Pearl Street

CINCINNATI, OHIO



Mystic Cutting Compound

When your work is coming fast, and production is needed badly, you will appreciate the speed increasing qualities of Mystic Cutting Compound. Mystic keeps tools cool and cutting edges in good trim. The leading lubricant for turrets, automatic bolt cutters, drilling and milling machines.

Let us send you a barrel on 30 days' approval, and convince you.

Cataract Refining & Manufacturing Co.

General Offices: Marine National Bank Building, Buffalo, N. Y.

PLANTS: BUFFALO—CHICAGO

Eastern Department, 17 Battery Place, New York City.

Western Department, 327 So. LaSalle St., Chicago, Ill.

Warehouses: Detroit, Boston, New York, San Francisco, Toronto, London, Eng.



Weco Electric Ovens For Dry Heat Tempering

Weco Ovens have been developed to the highest point of efficiency. They are simple, easily and perfectly controlled, clean, safe, and do their work rapidly and economically. Adapted for steel temper drawing, steel heating, brass and copper annealing, and for dry heat tempering of high speed and carbon steel tools. Temperature ranges from 70 degrees F. to 1100 degrees F. If you want accurate, uniform results you can get them with a Weco Electric Oven.

"Dry Heat Process of Temper Drawing" sent on request.

H. Boker & Company, Inc.

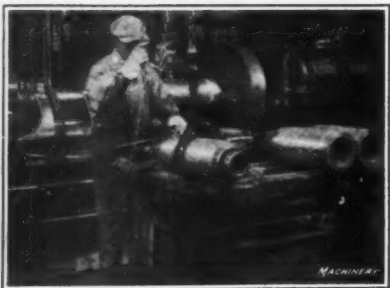
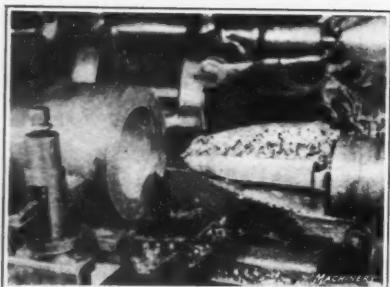
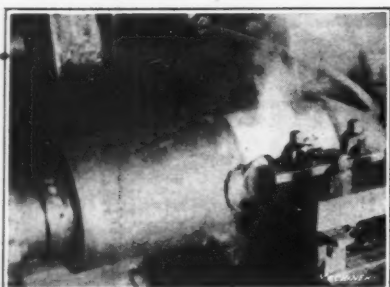
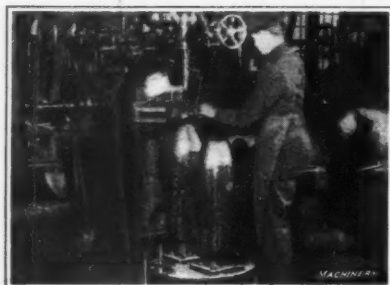
Formerly HERMANN BOKER & COMPANY

101 DUANE ST.

Established 1837

NEW YORK

CLEVELAND CHICAGO PHILADELPHIA MONTREAL BOSTON



MACHI MOTION

Showing clearly and vividly every
High-Explosive

THIS extraordinary motion picture continues MACHINERY'S "bit," which began with the remarkable treatise on Shrapnel Shell Manufacture printed *more than three years ago*, and has furnished the government as well as engineers and manufacturers a mass of definite specific information on mechanical methods and processes in the making of Shrapnel, High-Explosive Shells, Rifles, Gauges, and other devices of the utmost importance to a modern nation engaged in or preparing for war. MACHINERY was the first journal in the world to cover these subjects and did it long before Uncle Sam found it necessary to join the Allies. It was a work of preparedness, was read and studied by the whole engineering world—and it served in good time.

MACHINERY'S motion picture was arranged, made, and produced by MACHINERY'S Staff, and shows in detail every operation from the rough forging of the shell to the final inspection and packing for shipment. As a movie it is different. You see exactly what the cutting tool is doing and you see each test clearly made. Detail drawings flashed upon the screen between the operations show exactly what each step in the process means.

MACHINERY, 140-48

MACHINERY'S PICTURE

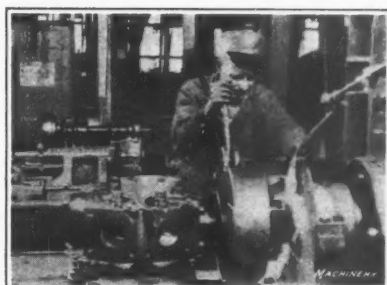
detail in the machining of a 9.2"
Howitzer Shell

THE picture has been shown with great success at the Cincinnati Convention of the American Society of Mechanical Engineers and the National Machine Tool Builders' Association, and before Engineering Societies, Superintendents' and Foremen's Clubs, Employers' Associations, and other industrial gatherings in Cleveland, Buffalo, Rochester, Syracuse, Fitchburg, Worcester, and elsewhere.

MACHINERY is arranging an itinerary to show this interesting film in all the leading industrial centers and will be glad to hear from mechanical societies, engineering schools, manufacturers and others interested. This is not a money making proposition and there is no charge for showing the picture or for the use of the film. All that is necessary is to provide the auditorium and the simple facilities required. Mr. Lucas of MACHINERY'S Staff gives a concise explanation of the operations as they are shown. Total time required is about thirty minutes. It is a real picture of actual operations in logical order and was taken in the High-Explosive Shell Department of the A. P. Smith Mfg. Co., East Orange, N. J.

**Write MACHINERY Now about
your Dates for the Fall.**

Lafayette St., New York



STANDARD PORTABLE TOOLS

PAY A GREATER RETURN THAN EVER BEFORE

Today is the day of intensive production—of crowding every hour full of productive activity. It's the day of the ever ready, easy to handle, universally useful, time-saving portable tool. Standard Portable "Electrics" are working where the drive is thickest—in machine tool and automobile plants, air-plane factories, railroad shops, etc., working hard and working profitably. They lead the field for accuracy, speed, power and endurance, and they are notably economical to use.

The list of Standard users reads like an industrial directory. It includes the U. S. Government and many of the largest manufacturers in the country.

The **STANDARD ELECTRIC TOOL COMPANY**

CINCINNATI OHIO, U. S. A.

New York Office
**Marbridge Bldg.
1328 Broadway**

Chicago Office
**10 So. LaSalle
Street**

We'll be glad to show you why your portable drills, reamers, grinders, etc., should be picked from the STANDARD Line.

Catalogue on request.



BROWN ELECTRIC PYROMETER

17800

DEGREES FAHRENHEIT

0 300 600 900 1200 1500 1800 2100 2400 2700 3000

RESISTANCE = 55.5 Ω

THE BROWN INSTRUMENT CO PHILADELPHIA PA

Put Your Heat-Treating Problems up to

The World's Standard Heat Meters

By far the majority of all firms using Pyrometers use Brown's. Baldwin's use 81 in their Eddystone Plants alone, Bethlehem use over 150. There are over 6000 other Brown users—each a Brown booster.

Let us send you the names of these in your territory so you can find out more about this success and what Brown's will save you. Write to the Brown Instrument Co., Philadelphia, or one of their district offices in New York, Pittsburgh, Detroit, or Chicago for complete information now.

Pawling & Harnischfeger Co. No. 52 Heavy Duty Vertical Drill

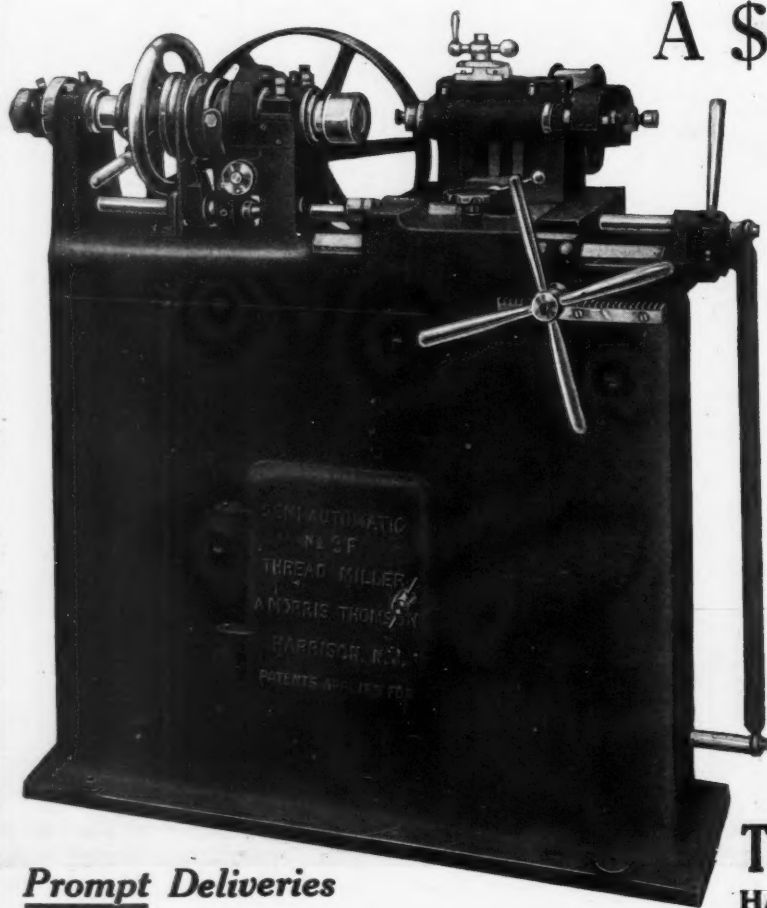
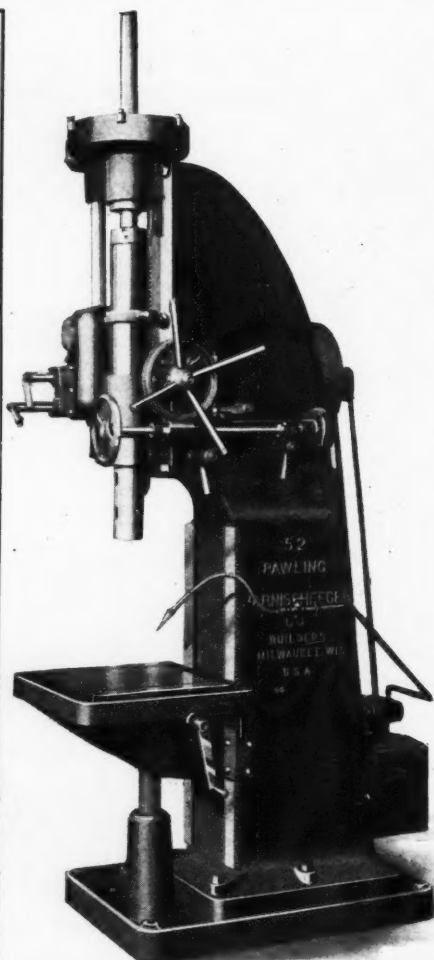
This P & H machine is of rugged construction throughout and is designed for the heaviest duty that may be required of a drill of this size.

A machine of this kind, which is master of its class, should surely have your attention long enough to convince you that it is an efficient and economical tool for your work.

Let us send complete description of the Drilling and Boring Machine suited to your work. Eleven sizes—all high grade, well built, wide-range machines.

DALE-BREWSTER MACHINERY CO., Inc.

545-547 West Washington Blvd., CHICAGO, ILLINOIS
30 Church St., NEW YORK



Prompt Deliveries

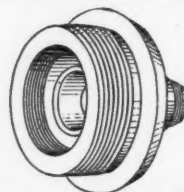
A \$650. Thread Milling Machine

A simple machine—operator has absolutely no thinking to do—levers to pull, that's all. Semi-automatic in operation. Extremely accurate. A big producer. Capacity to 3½" diameter, internal or external thread.

Let us send complete description.



BRONZE PRIMER
1" diameter. 14
Threads cut at
rate of 160
per hour.



BRONZE FUSE BODY
External Thread, 14
pitch; 2" diam. Cut
at rate of 160
per hour.

T.C.M. Manufacturing Co.
HARRISON NEW JERSEY

THE LANGELIER

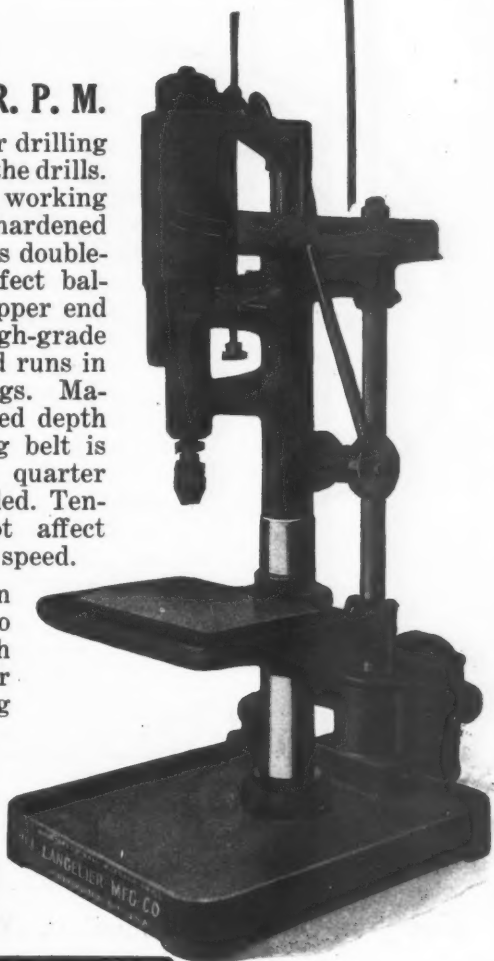
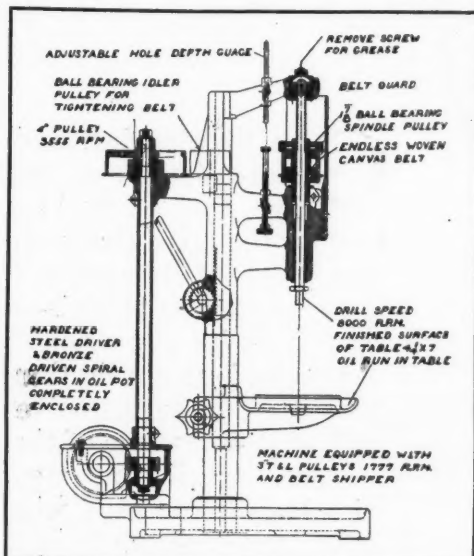
No. 1 High Speed Ball Bearing Drill, Eight Thousand R. P. M.

This high-speed ball bearing sensitive drill is built expressly for drilling holes up to $7/32$ " diameter, developing full cutting efficiency of the drills. It takes up to 6" in height and drills to 3" from edge. Table working surface, $4\frac{1}{4}$ " by 7". Total spindle feed 2". The spindle is hardened

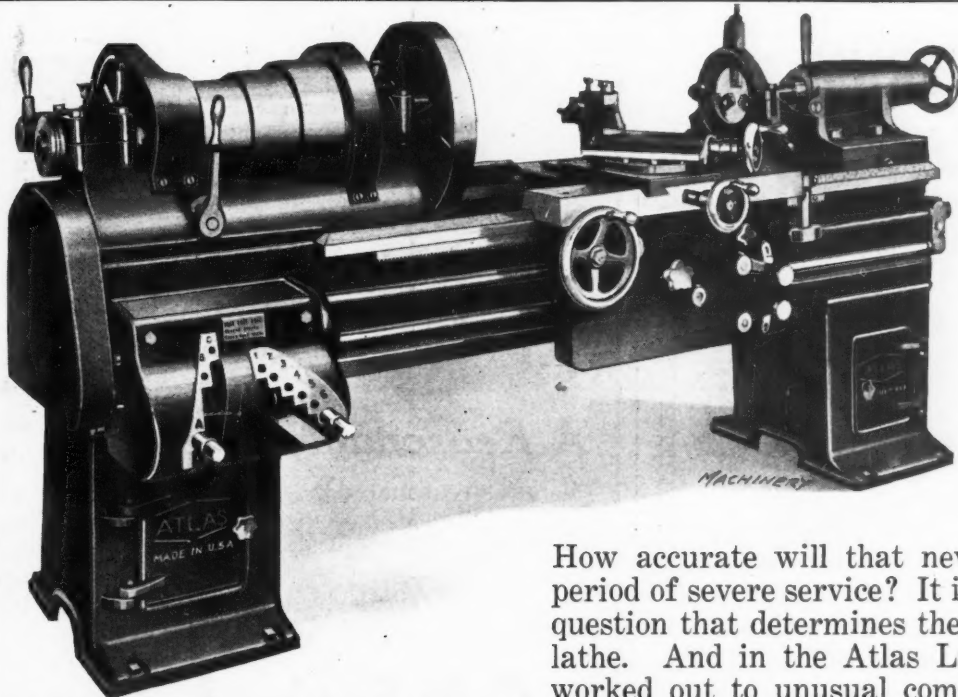
steel ground to size; it is double-splined to provide perfect balance at high speed. Upper end runs in imported high-grade ball bearings; lower end runs in phosphor bronze bearings. Machines have fine threaded depth gauge. Spindle driving belt is endless and without quarter turns. Tightener provided. Tension of belt does not affect sensitiveness of spindle speed.

Machines also made in No. 2 size for drills up to $3/8$ ". Both sizes in bench or floor types and either in single spindle or gang models as desired.

*These are remarkable tools
— write us for more details.
Quick deliveries.*



LANGELIER MANUFACTURING COMPANY
PROVIDENCE RHODE ISLAND

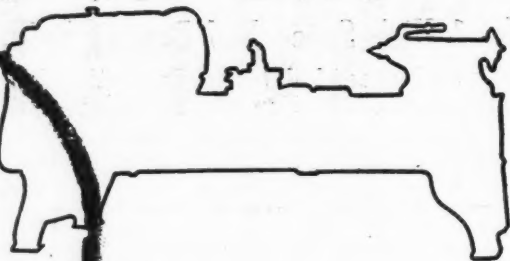


ATLAS Lathes

Travel a
Longer Road
of Accuracy

How accurate will that new lathe be after a period of severe service? It is the answer to this question that determines the real efficiency of a lathe. And in the Atlas Lathe the answer is worked out to unusual completeness. For instance, 20 per cent steel mixture in the "V" bearings provides a harder metal on the shears than in the carriage. Thus most of the wear is confined to the carriage and accuracy of alignment is preserved. There are other reasons why Atlas Lathes "travel a longer road of accuracy." Ask for details.

THE TAYLOR MACHINE CO., Cleveland, Ohio
Manufacturers of ATLAS Machine Tools



The
Cleveland Machinery & Supply Co.
 Main Office, CLEVELAND, OHIO

WORKS:

Hamilton, Ohio.

Columbus, Ohio.

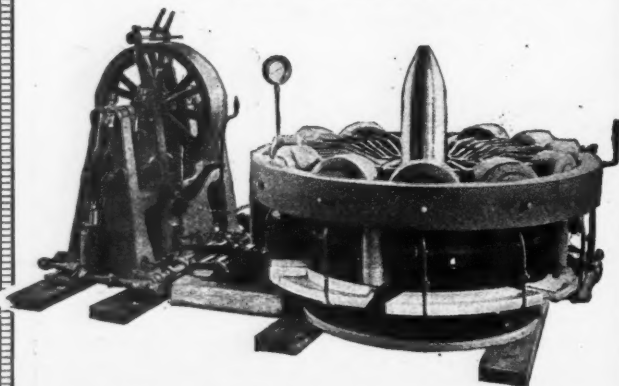
Richmond, Indiana

GET the circulars and more details covering the Simplex Lathe—the lathe that will take care of tomorrow's work as well as today's—the lathe with a margin of power and strength that provides for the future as well as it takes care of the present. Built by men who **know**—for men who know lathe values.

We'll be glad to answer questions and send more information. Write us.

The U. S. GOVERNMENT

*has made strict regulations
 with regard to banding shells.*

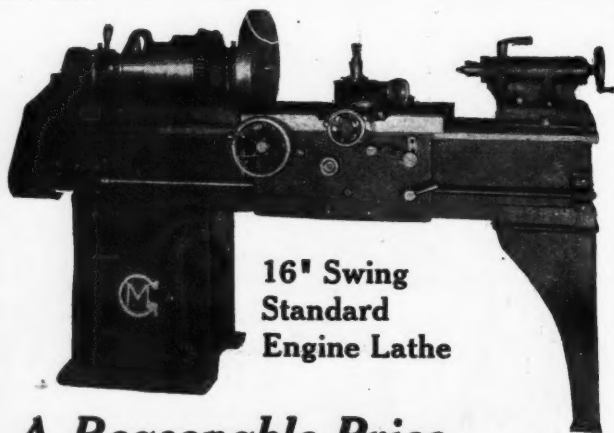


THIS Hydraulic Banding Machine meets all requirements, and bands any size shell from 15½" down.

The machine is also well adapted for general banding work of all kinds. It is a fast worker and built for hard service. A special feature holds bands in place as they enter the grooves and prevents shearing—an appreciable advantage.

Details on request.

The West Tire Setter Company
 ROCHESTER, N. Y.



**16" Swing
 Standard
 Engine Lathe**

A Reasonable Price

We offer reasonable price and early delivery as two very good reasons why you should buy G. M. Engine Lathes. They are good lathes mechanically—well built, tested, swing 16 inches, with single back gears, provided with ample oiling facilities, etc.

G-M Engine Lathes

Eight-foot bed only. Can be furnished with taper attachment if required. They are all you can require in a lathe this size.

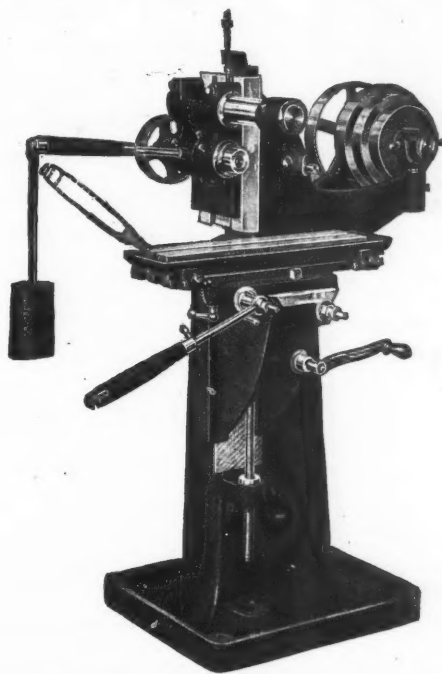
Let us send full particulars.

W. H. BOSWORTH, Cleveland, Ohio
 COMMERCIAL BANK BUILDING

“WHITNEY”

HAND MILLING MACHINE

THOUSANDS IN USE



PROMPT DELIVERIES

Owing to the increased demand for WHITNEY products we have recently completed another large addition to our factory. We have increased our production and are now prepared to make prompt deliveries on our Hand Milling Machine.

NOTE THE SLIDING HEAD

The handiest machine for light milling, keyseating, profiling, die sinking, gear cutting, etc. Powerful and simple in operation. Simply send for Catalog D.

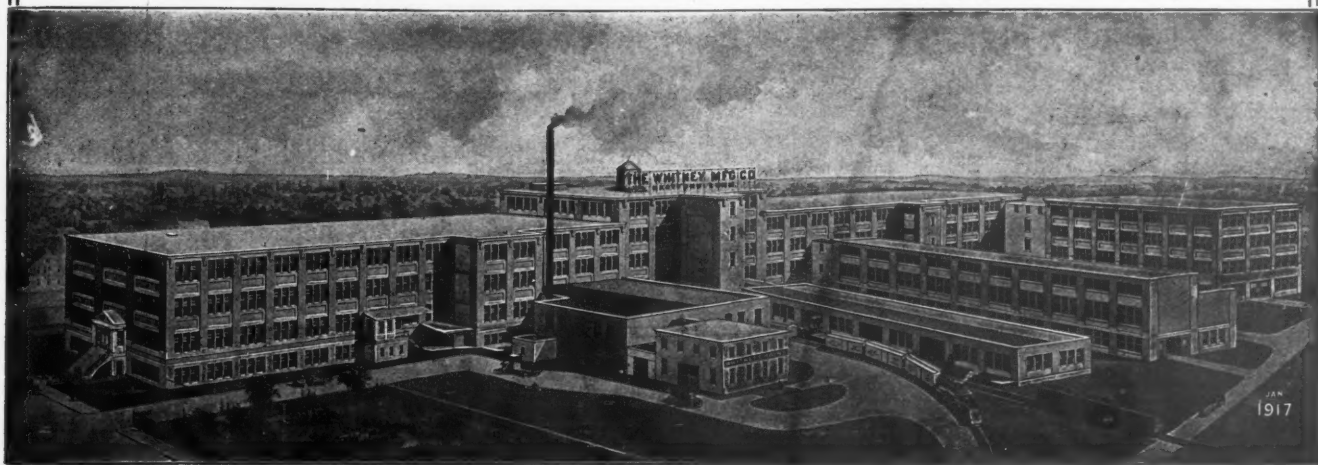
THE WHITNEY MFG. CO., Hartford, Conn.

CHAINS

KEYS

HAND MILLING MACHINES

FOREIGN AGENTS: Burton, Griffiths & Co., Ltd., London. Fenwick Freres & Co., Paris.





Price \$450

F. O. B. DAYTON

FOR SALE

No. 18 Lea-Simplex Cold Metal Saw

Manufactured by The Earle Gear and Machine Company, Philadelphia, Pa., complete with extra swivel block. Capacity 5" to 7" rounds and 6½" squares; an extra circular saw, type "BB"; serial number 1-46-11; perfect working order, practically good as new; belt driven.

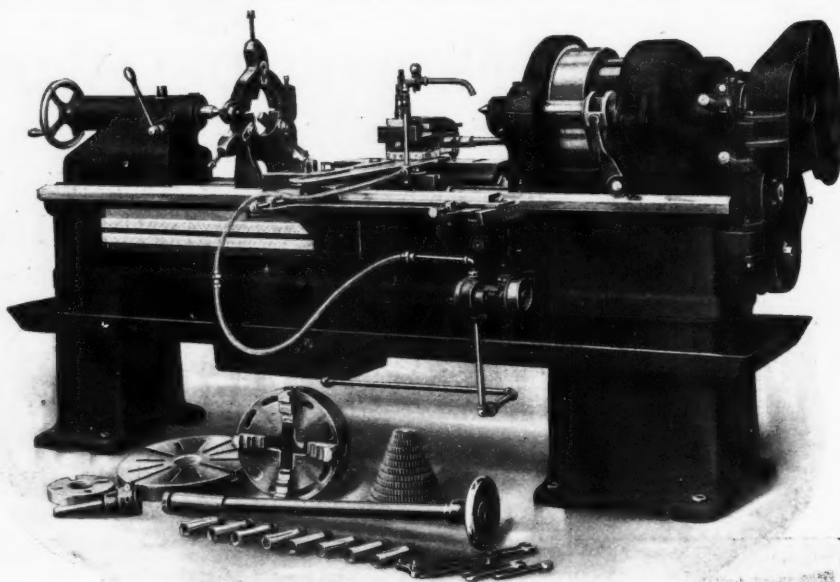
For Sale by

The Patterson Tool & Supply Co.

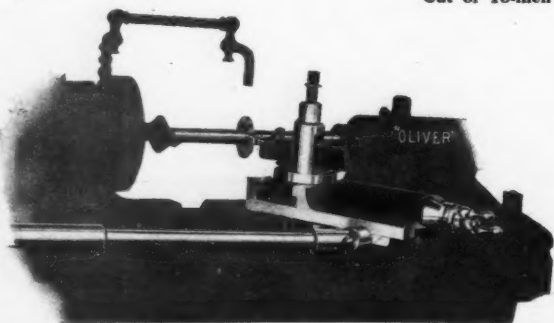
Dealers in Machinery, Tools and Supplies
DAYTON, OHIO, U. S. A.

OLIVER ENGINE LATHES

Built for your work, arranged with various Tool Room Attachments, Belt or Motor Drive, with or without Chip and Oil Pan Pump, etc. Any length of bed to suit your particular needs.



Cut of 18-inch Tool Room Lathe Equipped with Taper, Draw-in and Relieving Attachments



Relieving Attachment Doing Business

Engine Lathes—26-inch, 18-inch, 16-inch.

Turret Lathes—16-inch.

Screw Machines—2¼-inch.

Speed Lathes—12-inch.

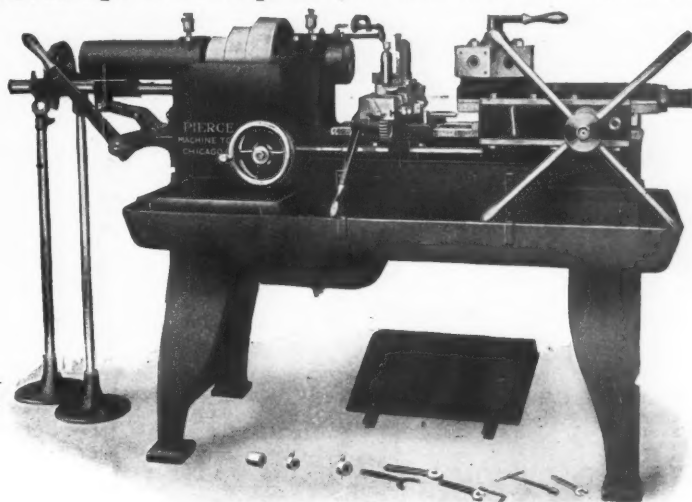
OLIVER MACHINERY CO.

No 7 Coldbrook St. GRAND RAPIDS, MICH.

Accuracy, Speed, and Unusual Range

The Pierce Turret Screw Machine in operation is one of the speediest and most convenient machines of its kind on the market. We have made the "Pierce" rigid and strong, provided more power than is ever apt to be required, and made the machine a joy for the operator to handle. Spindle is carefully machined and hardened, has minimum overhang and is free from vibration regardless of speeds or class of work. Turret is rigidly constructed and automatically locked, directly under the cutting tool, when indexed.

Actual capacity is 1 1/16" x 8". In every important detail the "Pierce" is of greater dimensions than any other machine of similar capacity.



Complete description on request.

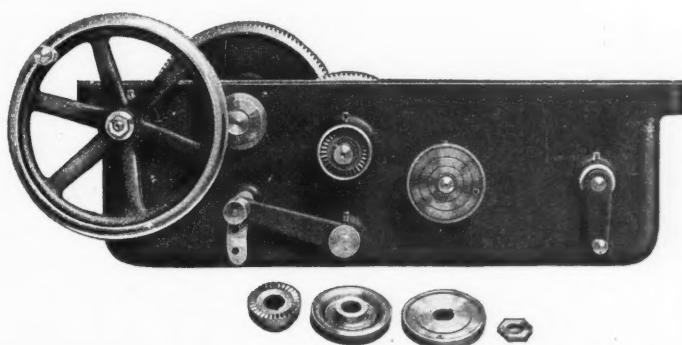
Actual Capacity 1 1/16" x 8"

617 W. Jackson Blvd.

PIERCE MACHINE TOOL CO.

Chicago, Ill., U. S. A.

HIGH GRADE TURRET MACHINERY



APRON POWER

to Feed the Carriage Against Heavy Cuts is Provided in Our Large Lathes

The above front view of apron partly dismantled shows construction of positive, toothed clutch (no frictions employed). The arrangement of the discs which carry the shearing pin is also shown. This shearing pin will break before the all-steel gearing will give way.



**LARGE SWING LATHES BUILT
IN 30", 36" 42", 48", 54" AND 60" SIZES**

**THE HOUSTON, STANWOOD & GAMBLE COMPANY
CINCINNATI, U. S. A.**

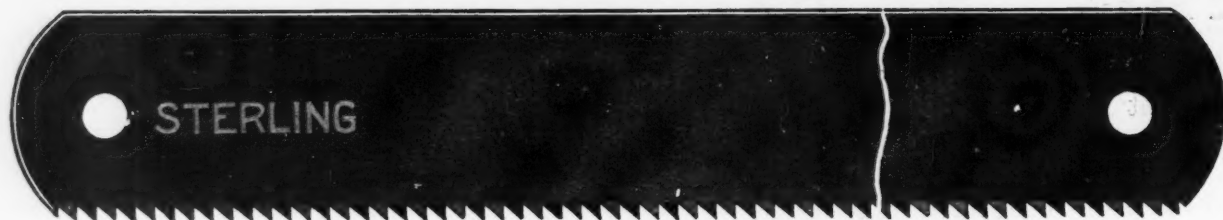
DOMESTIC REPRESENTATIVES:

Hill, Clarke & Co., Inc., Boston
Sherritt & Stoer Co., Philadelphia
William K. Stamets, Pittsburgh

The Vonnegut Machinery Co., Indianapolis
The Stocker-Rumely-Wachs Co., Chicago
P. H. McArdle, New Orleans

Louis G. Henes, San Francisco

S-T-E-R-L-I-N-G



THE HACK SAW BLADE OF REAL MERIT
Diamond Saw & Stamping Works, Buffalo, N. Y., U. S. A.

The

Avel



Ball Bearing Drilling Machines

Sizes, Speeds, Capacities to suit each specific job

**High
Speeds
Clean
Holes**

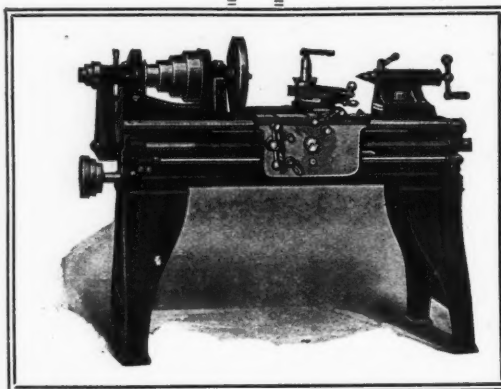
Our No. 3 Machine provides maximum speeds for work up to 1 1/8-inch.

Our No. 1/2 machine for light work may be run at 12,000 r. p. m.

Other Sizes for Intermediate Work

Real manufacturing means specializing. Get the right machine.

The Cincinnati Pulley Machinery Co.
CINCINNATI



SIMPLICITY in construction yet embodying all necessary features and backed up by perfect workmanship is what we offer in a

SEBASTIAN

13—14—15-INCH SWING

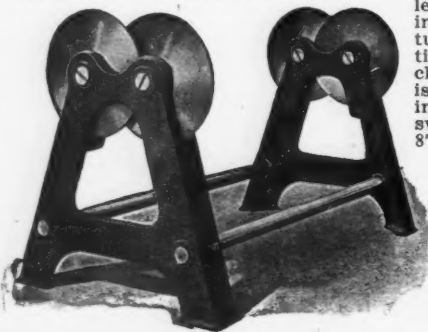
You Need One in Your Shop for Certain Jobs

The Sebastian Lathe Co.

154 Culvert St., Cincinnati, Ohio, U. S. A.

NO ADJUSTMENT NEEDED

The Twentieth Century Balancing Tool requires no adjusting. It is always level and ready for instant use no matter where or how you place it. Simplest way to balance pulleys, cones, polishing wheels, armatures, etc. A practical tool for machine shop and polishing room. Made in four sizes to swing from 22" to 8'.



Ask for the circular

Manufactured by

ROCKFORD TOOL CO.

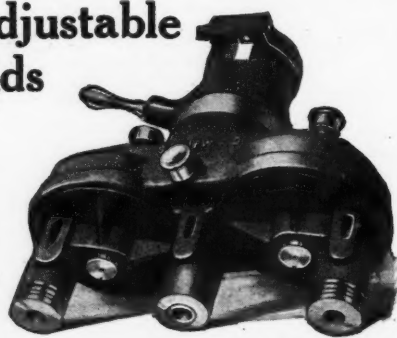
Rockford Ill.

Sellew Adjustable Drill Heads

SAVE MONEY

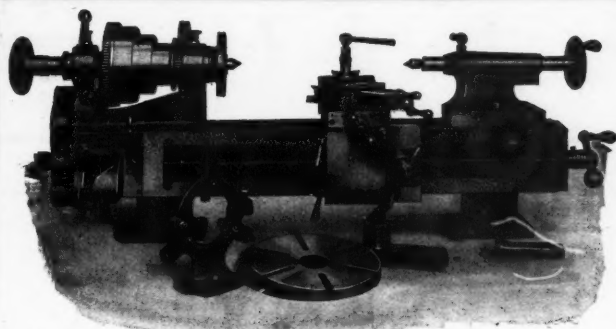
Three Holes at once instead of one.

Write for details



SELLEW MACHINE TOOL CO.

Pawtucket, R. I., U. S. A.



Wade 8" Precision Lathe

This lathe is designed for tool room, experimental and scientific work—for use wherever close accuracy is of prime importance. Nothing but the best in design and construction; only honest values go—for the Wade is built to take a permanent place in the machine tool field.

A strong feature is the quick change gear mechanism which provides for any thread from 12 to 120 per inch. Other features include a set of eleven spring chucks, two face plates, ground tool-steel bearings and draw-in type spindle, covered gears, etc.

Complete description on request

WALTER H. WADE

311 Atlantic Ave.

Boston, Mass.

AGENTS: T. Crowther & Co., Boston, Mass. L. R. Meisenhelter Machinery Co., Philadelphia, Pa. E. A. Kinsey Co., Cincinnati, Ohio. International Commercial Co., New York, for Russia. Alfred Herbert, Ltd., Coventry, England. Charles Churchill & Co., Ltd., London, Eng.

BLOMQUIST-ECK

No. 1 DRILL

Simple
Low Cost
An
Excellent
Investment

*Details
on
Request*



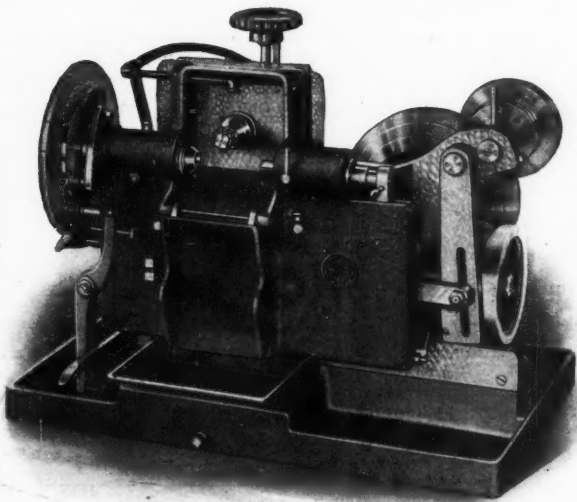
There's a place for this drilling machine in your shop if there is any quantity of bench drilling to perform. This drill answers requirements with the same speed, accuracy and uniformity that has always characterized Blomquist-Eck Machines. It is strong, compact, has two speed changes, drills up to 1/2".

The
Blomquist-
Eck Machine
Company

AGENTS: Northern Mchy. Co., Minneapolis, Minn. Strong, Carlisle & Hammond Co., Cleveland, Ohio. Easley Mchy. Co., Chicago, Ill.

203 St. Clair Ave., N.E.
CLEVELAND, OHIO

The Waltham 4" Precision Gear Cutter



A profitable little machine for the shop that makes small gears and fine pitch pinions. The "Waltham" is automatic in operation, has all working parts protected and is a speedy producer of accurate work. When cutter slide is in cutting position and cut in progress, it is tightly clamped; clamp is released on return stroke so slide may be lifted for indexing.

Complete description on request.

Waltham Machine Works

Newton Street

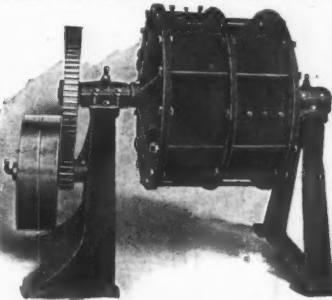
WALTHAM, MASS.

Small Thread Millers, Gear Cutters and other small Automatic Machines



Burnishing Up-to-Date

The modern idea of burnishing small metal parts—the most in the shortest time—is developed to the last notch by the Abbott Tumbling Barrel process. Hand polishing turns out one piece at a time, Abbott polishing—hundreds. Finish is perfectly clean and uniform, secured without injury to the work. And it's particularly cheap in labor—one operator handling four or five machines.



*We'll gladly burnish samples
of your work free and
estimate on costs.*

THE ABBOTT BALL COMPANY

(ELMWOOD)

HARTFORD CONN.

Second-Hand Machinery, Tools and Accessories

NEW, REBUILT AND



USED MACHINERY

USED MACHINERY

BORING MACHINES

No. 1 Beaman & Smith hor., double head.
2 spindle Beaman & Smith hor.
24" Bullard vert., 2 heads.
30" Bullard vert., 1 head.

DRILLS

24" Henry & Wright, B.B., sensitive.
4 spindle Foote-Burt, P.F.
4 spindle Gardam sensitive.
4 spindle Barr sensitive.
6 spindle Gardam.
28" Blaisdell sliding head.
36" Prentice Bros., upright.
36" Bickford sliding head.
4" Bickford plain radial.
4" Bickford full universal radial.

GRINDERS

No. 6 Bryant, internal.
No. 1 Norton univ., C.&T.
No. 4 Springfield planer type surface.
No. 5 Rivett, on stand.
No. 200 Heald ring.
No. 3 1/2 Van Norman radial.
No. 4-12 x 60 Landis universal.
No. 2 Garvin hole.
12 x 60 Diamond Surface.
12 x 30 Landis plain.

LATHES

11 x 5 Barnes, C.R., P.C.F.
15 x 8 Hamilton, plain rest, T.A.
16 x 8 Porter C.R., P.C.F.
16 x 6 Automatic threading.
18 x 6 Reed C.R., P.C.F.
18 x 8 Lodge & Shipley C.R., P.C.F.
18 x 8 American C.R., Q.C.T.A.
18 x 8 Rahn-Mayer C.R., P.C.F., chuck.
20-18 x 8 L. & S. 3-step, Q.C.
26 x 14 Gleason C.R., P.C.F.
5-22 x 10 L. & S. selective head.
30 x 10 Gleason, swivel rest.
36 x 14 Pond, C.R., P.C.F.
20-42 x 12 F. & S. gap, motor drive.

MILLERS

No. 3 Reed plain.
No. 13 Brainerd universal.
No. 2 Garvin universal.
No. 3 1/2 Garvin plain.
25 Lincoln pattern, assorted.
Nos. 1 and 2 P. & W. hand.
No. 12 B. & S. plain, belt feed.
Grant Mfg. Miller.

PLANERS

24 x 24 x 6 Wheeler.
26 x 26 x 5 Pond.

SCREW MACHINES

21" Gisholt Turret Lathe.
18 x 7 Fay & Scott universal turret.
1" Smurr & Kamen, wire feed.
3-2 x 24 Jones & Lamson.
2-24" Gisholt, turret lathe.
3/4" Rivett, collet chucking attachment.
1/2" National Acme automatic.
1/2" P. & W. automatic.
3/4" Cleveland automatic.
20" J. & L. geared head.
20-2" Cleveland automatics.

MISCELLANEOUS

No. 1 Baker Bros. Keyseater.
30 ton Watson-Stillman bending mch.
675 lb. P. & W. board drop hammer.
14" Steptoe shaper.
16" Rochester shaper.
24" Hendey shaper.
4" Espen-Lucas saw.
26 x 10 Cincinnati gear cutter.
2-No. 1 Slate pinion cutters.

HENRY PRENTISS & COMPANY, Inc.

FORMERLY

PRENTISS TOOL & SUPPLY CO.

Singer Building, 149 Broadway, NEW YORK

BOSTON, MASS.

BUFFALO, N. Y.

ROCHESTER, N. Y.

SYRACUSE, N. Y.

SCRANTON, PA.

Warehouse: 439 Communipaw Avenue, Jersey City, N. J.

Second-Hand Tools

- 1-3/8 Cleveland Automatic.
- 4-5/8 Automatic Screw Machines.
- 3-3/4 Hartford Automatics.
- 5-1 3/8 Hartford Automatics.
- 5-2" Cleveland Automatics.
- 2-2" Davis & Egan Automatics.
- 1-2 1/4 Gridley Automatic M.D.
- 2-1 1/2 x 6 Gray Screw Machines.
- 1-24 x 24 x 6 American Planer.
- 1-32 x 32 x 8 S. H. New Haven Planer.
- 1-40 x 36 x 10 S. H. New Haven Planer.
- 56 x 42 x 16 D. H. Gray Planer.
- 1-Grindstone and Frame.

The Cincinnati Planer Co.

CINCINNATI, OHIO

FOR SALE

- 1-3' Pratt & Whitney Vertical Surface Grinder with magnetic chuck.
- 1-5" x 48" P. & W. Plain Cylindrical Grinder.
- 1-No. 2 Bath Universal Grinder.
- 2-12" x 36" Landis Plain Grinders.
- 1-No. 13 B. & S. Automatic Gear Cutter.
- 1-No. 3 B. & S. Automatic Gear Cutter.
- 1-30" Eberhardt Bros. Automatic Gear Cutter.
- 1-30" Old Style Brainers Automatic Gear Cutter.
- 2-12" Gleason Single Tool Gear Generators.
- 2-Lees Bradner Thread Millers.
- 2-Reed Plain Milling Machines.
- 1-No. 3 Brown & Sharpe Plain Milling Machine.
- 2-No. 4-B Becker Vertical Millers, new.
- 5-No. 3 Bristol Vertical Millers, new.
- 4-14" x 5' Reed Engine Lathes, R. & F.
- 1-14" x 6' Rockford Engine Lathe.
- 10-14" x 6' Flather Engine Lathes, new.
- 1-16" x 7' Oliver Engine Lathe, new.
- 1-16" x 8' CISCOS Engine Lathe, new.
- 3-18" x 8' Davis Engine Lathes, D.B.G.
- 1-20" x 6' Florence Turret Chucking Lathe.
- 1-20" x 8' Bullard Chucking Lathe.
- 1-22" Cincinnati Type "B" Double Head Traverse Head Shaper, 10', new.
- 1-15" x 30" Cincinnati Open Side Shaper, new.

BROWNELL MACHINERY CO.
PROVIDENCE, R. I.

For Sale, Immediately, Electrical Equipment

- 2 Elevators, complete, two and three ton capacity, with 20 and 30 H.P. Crocker-Wheeler motors.
 - 20 Switches, various sizes.
 - 12 Lighting Transformers.
 - 2 Remok Transformers.
 - 3 Type "T" Auto Transformers.
 - 14 Current Transformers.
 - 8 Potential Transformers.
 - 6 Conduit Series Transformers.
 - 10 Miscellaneous Transformers.
 - 10 Marble Slabs.
 - 7 Circuit Breakers.
 - 2 Batteries of Conduit Oil Switches, three and six units.
 - 17 Meters—Watt Meters—Volt Meters—Watt Hour Meters, etc.
- Numerous other items in electrical equipment. Want to sell in one lot—write at once for complete list if interested.

The Goodyear Tire & Rubber Co., Akron, Ohio

FOR SALE

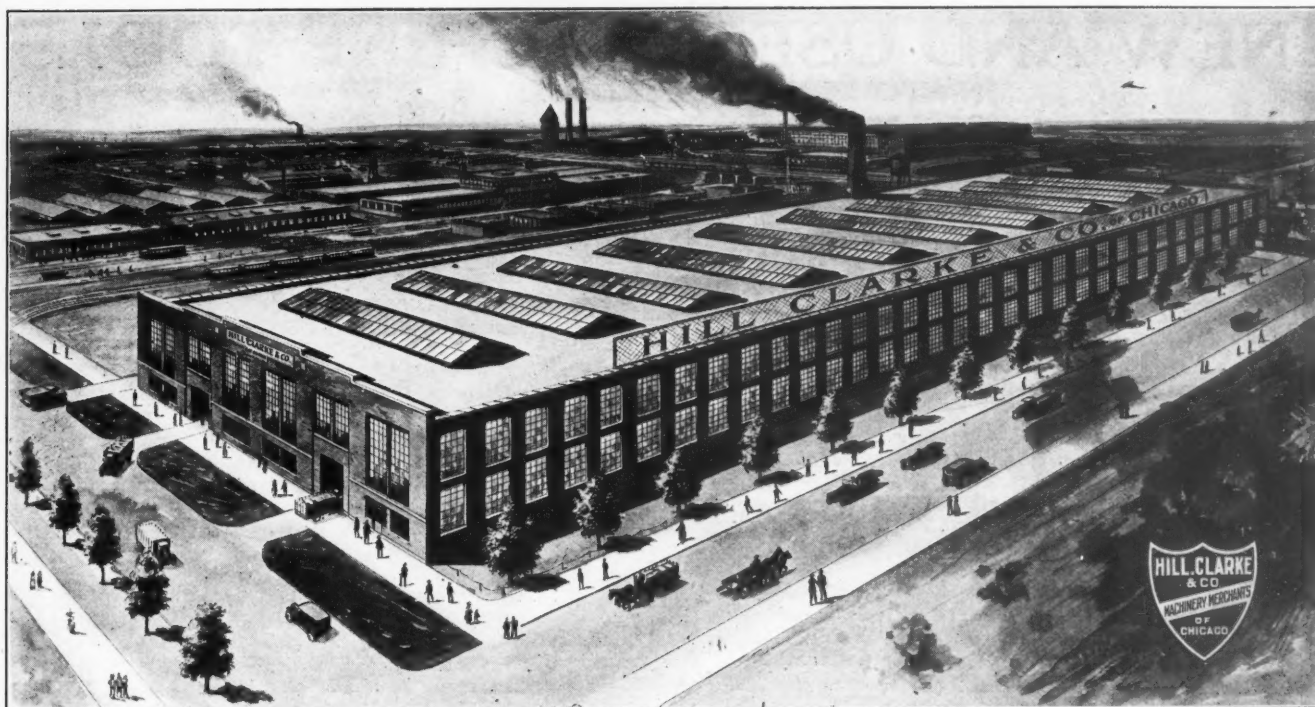
Shell Making Machines

For Immediate Delivery

- 64-6" Shell Making Machines, with all attachments.
- 25-9.2 and 12" Shell Making Machines, some arranged for motor drive, and others for belted drive.

For further particulars inquire of

The Cleveland Machinery & Supply Co.
CLEVELAND, OHIO



The Only Re-Manufacturing Plant in the World, 55,000 Sq. Ft. of floor space

TURRETS—Latest Models

- 25—21" Gisholts, 2-step, 5" belt, 3½" hole.
- 25—21" Gisholts, motor arrangement, 3½" hole.
- 15—24" Gisholts, 3-step, 4" belt, 4¼" hole.
- 40—24" Gisholts, 2-step, 6" belt, 6" hole.
- 42—24" Gisholts, motor arrangement, 6" hole.
- 4—3-A Warner & Swasey.

ENGINE LATHES—Latest Models

- 24—22" x 8' Hamilton, D.B.G., C.R., Semi-Q.C.G.
- 5—22" x 8' Hamilton, D.B.G., turret tool post.
- 7—22" x 10' Hamilton, D.B.G., C.R., Semi-Q.C.G.
- 2—22" x 10' Hamilton, D.B.G., turret tool post.
- 20—22" x 10' Davis, D.B.G., C.R., Q.C.G.

VERTICAL BORING MILLS

- 1—30" Baush.
- 1—32" Rogers.
- 2—34" Colburn.
- 1—36" Brown & Sharpe Chucking.
- 1—42" Colburn, 2 hds.
- 1—51" Baush, 2 hds.

RADIALS

- 3—2½' Fosdick.
- 2—2½' Mueller.
- 1—2½' Dreses.
- 1—3' Prentice.
- 1—3' Mueller.

- 1—3½' Gang.
- 1—4' Niles Full Universal.
- 3—5' Niles Semi-Universal.

PLANERS

- 1—22" x 22" x 5' Flather.
- 1—22" x 22" x 6' American.
- 1—24" x 24" x 4' Gray.
- 2—24" x 24" x 5' Gray.
- 1—24" x 24" x 6' Cincinnati.
- 1—24" x 24" x 10' Lodge & Davis.
- 1—26" x 26" x 6' American.
- 1—30" x 30" x 10' Powell, 4 hds.
- 1—32" x 32" x 8' Gray, 2 hds.

- 4—22" x 8' Davenport, D.B.G., turret tool post.
- 8—24" x 10' Lodge & Shipley, D.B.G., C.R., Q.C.G.
- 8—24" x 10' Lodge & Shipley, Selective Gd. Hd., C.R.
- 11—26" x 10' American, D.B.G., C.R., Q.C.G.
- 2—25" x 10' American, D.B.G., carriage turret.
- 19—26" x 12' Putnam, carriage turret, Semi-Q.C.G.
- 9—26" x 12' Putnam, C.R., Semi-Q.C.G.
- 2—26" x 12' Wickes, D.B.G., C.R. Semi-Q.C.
- 10—28" x 10' Niles, Bement, Pond, Q.C.G.
- 4—28" x 14' Lodge & Shipley, Select. Gd. Hd., C.R., carriage turret.
- 3—30" x 16' Lodge & Shipley, Select. Gd. Hd., C.R., carriage turret.
- 11—40" x 18' Pittsburgh Triple Geared, Q.C.G.

- 1—32" x 32" x 10' Gray, 2 hds.
- 1—76" x 48" x 18' Woodward & Powell, 4 hds.

PRESSES

- 1—No. 30 Perkins Inclined.
- 1—No. 5 Niagara Geared.
- 1—No. 5 Consolidated.
- 1—No. 20-U Ryerson Punch.
- 3—No. 73½ Bliss S. S. Trimming.
- 1—No. 23½-B Niagara Toggle.
- 1—Long & Allstater Geared Punch.
- 1—No. 17 Williams & White Double End Punch.

MILLERS

- 1—No. 3 Brainard Plain.
- 1—No. 20 Oesterlein Universal.
- 1—No. 1½ Brown & Sharpe Universal.
- 1—No. 25 Becker Plain.
- 1—No. 2 Cincinnati Universal.
- 1—No. 5 Schuchardt & Schutte Plain.
- 1—No. 3 Hendey Plain.
- 1—60" x 48" x 8' Ingersoll Slab.
- 1—Beaman & Smith, 2 vert. hds., 1 horiz. hd.
- 1—No. 2 Beaman & Smith Combination.

GEAR CUTTERS

- 1—No. 1 S. & S. Hobber, spiral.
- 1—No. 12 B. & S., spur and bevel.
- 1—24" Fellows Gear Shaper.
- 2—No. 3-26" Cincinnati Spur.
- 1—36" Fellows.
- 1—36" Gleason Former, spur and bevel.
- 1—84"—96" Gleason Planer, spur and bevel.

ReMANUFACTURED —(ORIGINATED BY US)— MACHINE TOOLS

Our Guarantee:—Your money back, if you return machine within 30 days from date of shipment, freight prepaid. No excuses necessary.

Our new "Green List" just out, describes the above machines and hundreds of others. Write for one.

HILL, CLARKE & CO. of CHICAGO
625 Washington Blvd. CHICAGO, ILL., U. S. A.



NEW AND USED MACHINE TOOLS

IN STOCK FOR IMMEDIATE DELIVERY

RADIAL DRILLS (Used)

1—3' Bickford Plain Radial, Gear Box Drive.

THREAD MILLER (Used)

1—No. 3 Lees-Bradner (used one month)

MILLING MACHINES (New)

1—No. 3 Rockford Hand Miller.

3—U. S. Plain Hand Millers (Whitney type).

2—Standard Hand Millers (Whitney type).

MILLING MACHINES (Used)

2—No. 2 Garvin Hand Millers, Lincoln type.

3—No. 1 Steptoe Hand Millers with vise and arbor.

1—No. 3 Cincinnati Plain Miller.

SHAPERS (Used)

1—20" Queen City B.G. (like new).

SCREW MACHINES (New)

3—No. 0 Foster Plain Head, 9/16 wire feed capacity.

1—No. 2 Foster Plain Head, 11/16 wire feed capacity.

2—No. 4 Foster Geared Fr. Head, 19/16 wire feed capacity.

1—No. 6 Foster Geared Fr. Head, 21/16 wire feed capacity.

1—No. 140 Wells (7/8 capacity).

1—No. 2 1/2 Garvin (17/16 capacity).

SCREW MACHINES (Used)

1—1/2 Pratt & Whitney Automatic Screw Machine.

1—Foster No. 4 Motor Driven Screw Machine.

1—No. 52 Acme 4-spindle, 3/4" capacity automatic.

GRINDERS (New)

1—Capital Internal Grinder, capacity 3/16" to 2 x 2.

1—Greenfield Universal Grinder.

1—No. 1 Wilmarth & Morman Surface Grinder.

1—Wilmarth & Morman No. 2 Full Automatic Surface.

2—No. 190 Wells Tool and Cutter Grinder.

6—Dumore Portable Electric.

GRINDERS (Used)

1—No. 190 Wells.

1—No. 1 Landis Universal.

POWER SQUARING SHEAR (Used)

1—60" Niagara Power Squaring Shear, capacity 1/8 stock.

BENCH LATHES (New)

2—No. 5 1/2 Sloan & Chace, Comp. slide, 3 speed, c/s 10 col.

1—Ames Compound Slide, 3 speed, c/s 10 collets.

LATHES (New)

2—13 x 6 Worcester, P.C., C.R.

1—14 x 6 Hamilton, Q.C., C.R., Sgl. B.G.

3—16 x 8 Flather, Q.C., C.R., Dbl. B.G.

2—18 x 8 Hamilton, Q.C., C.R., Sgl. B.G.

1—20 x 6 Rahn-Larmon, Q.C., C.R., Dbl. B.G.

1—20 x 10 New Haven, P.C., C.R., Dbl. B.G.

1—26 x 10 Lodge & Shipley, Q.C., C.R., Dbl. B.G.

LATHES (Used)

1—12 x 5 Seneca Falls, P.C., C.R.

1—14 x 8 Davis, Q.C., C.R., with chuck.

1—18 x 8 Davis, Q.C., taper attachment, pan bed.

1—20 x 10 Jones & Lamson, P.C., C.R.

1—20 x 12 Greaves-Klusman, Q.C., C.R., taper attachment.

1—28 x 10 Hamilton, Q.C., C.R.

1—16 x 6 Lodge & Shipley Geared Head.

DRILL PRESSES (New)

6—10" Sensitive Bench Drill Presses with chuck.

3—14" U. S. Sensitive Drills.

2—20" Buffalo B.G. self-feed automatic stop.

2—20" Barnes plain lever and worm feed.

2—20" Barnes B.G., self-feed automatic stop.

3—20" Champion B.G. self-feed automatic stop.

1—2-spindle No. 32A Reed Sensitive.

DRILL PRESSES (Used)

1—Sgl. Spindle Sipp High Speed.

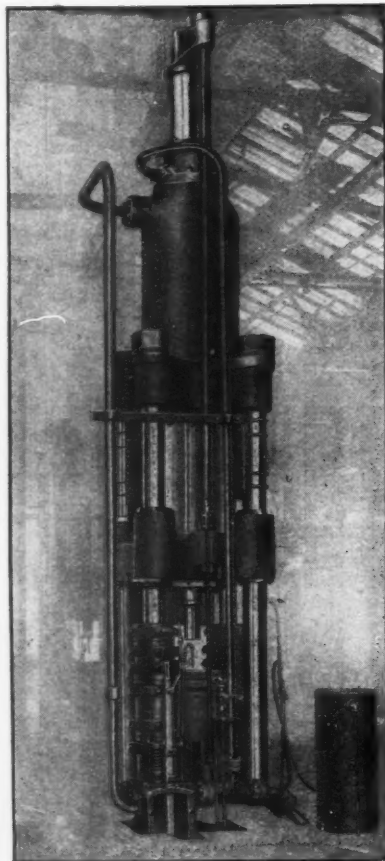
1—20" Excelsior B.G. Auto. Feed.

1—25" Hamilton B.G. Sliding Head.

3—23" Snyder B.G. Automatic Feed.

1—24" Barnes Sliding Head.

HOMER STRONG, Successor to Strong & Hery Company
309 STATE STREET ROCHESTER, N. Y., U. S. A.



FOR SALE

Two 350-Ton Vertical Hydraulic Presses

CAPACITY - - - UP to 6" H. E. Shell Forgings

PRODUCTION - - - 5" Forgings, 3,000 in 20 hours

Immediate Delivery

Including pumps, motors, accumulator, valves, underground and overhead piping, fittings, single and double holder die blocks, and all other accessories for complete units, ready for operation, except heating furnaces.

These units are two of four used for forging H. E. shell blanks. Operated less than six months. In first-class condition.

Also offer for sale complete units for machine finishing 4.5", 5" and 6" H. E. shells.

For detailed description, price, terms, etc., address

THE UNION SWITCH & SIGNAL CO.
SWISSVALE PENNSYLVANIA, U. S. A.

W. F. DAVIS MACHINE TOOL CO.

CHICAGO, ILL., 549 W. Washington Blvd. CLEVELAND, O., 508 Leader News Bldg.
CINCINNATI, OHIO, 1018 Union Central Life Bldg.
NEW YORK CITY, Singer Bldg.

BORING MACHINES—VERTICAL

- 1—30" Colburn, one turret head.
- 1—34" Rogers, one turret head, September delivery.
- 1—34" Gisholt, including motor.
- 2—36" N.-B.-P., one plain and one swivel head.
- 2—36" B. & S., one turret head.
- 12—New 42" Putnam, two heads, November delivery.
- 1—53" N.-B.-P., two swivel heads.
- 1—72" Niles, two swivel heads.
- 1—New 8" Bickford, December delivery.

BORING MACHINES—HORIZONTAL

- 1—Lucas, 2 1/4" bar.
- 1—Hoefler Horizontal Driller and Borer, with 1 1/16" spindle; vertical adjustment, 40"; horizontal adjustment, 46"; size of table, 33" x 48".
- 2-spindle Beaman & Smith, 3 3/4" bar. Page 48, G. of G. 1907 Cat.

BULLDOZERS

- 1—New No. 4 Garrison (same as No. 4 Williams-White).
- 1—No. 7 Ajax, 20" stroke.
- 1—No. 7 High Speed Ajax, 16" stroke.

COMPRESSORS—AIR

- 1—8" x 8" Curtis, belt driven.
- 1—10" x 10" x 10" Single Cylinder Smith-Valle, steam driven.
- 1—10" x 12" Chicago Pneumatic, belt driven.
- 1—10 x 16 1/2" x 13" Peerless, cross compound, steam driven.
- 1—22" x 13" x 16" Ingersoll-Rand, motor driven.
- 1—Ingersoll-Sargent Duplex, 8 x 14 1/2 x 8".
- 1—Ingersoll-Sargent, steam driven, 345 cu. ft.
- 1—Cincinnati, cross compound, two stage, 790 cu. ft.

CUTTING-OFF MACHINES

- 2—No. 00 Brown & Sharpe.
- 1—2" capacity Warner & Swasey.
- 4—3 1/2" Hall.
- 10—4 1/2" Williams.
- 3—4" Curtis & Curtis.

DRILLING MACHINES—RADIAL

- 2—New No. 3 American, plain, cone drive.
- 3—New 3" Americans, sensitive tapping attachment.
- 7—New 3" Prentice, July delivery.
- 1—New 3" Mueller, plain, speed box drive.
- 1—New 3 1/2" Mueller, cone drive, July delivery.
- 1—New 3 1/2" Western Drill, 86" circle.
- 2—4" Mueller, plain, speed box drive.
- 1—3" Bickford, gear drive.
- 1—5" Bickford, plain, speed box drive.
- 1—5" American, plain, motor drive.
- 5—5" Spindle, arm does not raise and lower, hand feed.
- 1—5" Fosdick, plain, cone drive, tapping attachment.
- 1—6" Baush, plain, cone driver.

DRILLING MACHINES—HEAVY DUTY

- 3—No. 14 Colburn, 24" swing, capacity 2" in solid steel.
- 2—No. 3 Colburn, plain, table.
- 2—No. 26 Foote-Burt, 44" swing, 3 1/2" capacity in solid steel.
- 1—No. 310 Baker, single pulley drive, late type.

DRILLING MACHINES—MULTIPLE SPINDLE

- 1—No. 30 C. Baush, 12 spindle, capacity 1 1/4" holes, 30" circle.
- 1—No. 24 Baush, 12 spindles.
- 1—Gardam, 12 spindle, capacity 3/4" holes, 14" square.
- 1—14-spindle Baush, capacity 1" holes, 36" circle.
- 1—No. 11 Pratt-Whitney, 16-spindle, cap. 10 spindles, 1/4" cap.

GEAR CUTTING MACHINES

- 1—New 6" Standard Gear Cutter, Spur.
- 1—12" G. & E. Gear Hobber.
- 1—12" Gleason Bevel Gear Planer.
- 1—15" Gleason Bevel Gear Planer.
- 1—16" Bilgram Bevel Gear Generator.
- 1—20" Grant-Lee Gear Hobber.
- 1—No. 1 20" Schuchardt & Schutte Gear Hobber.
- 1—22 x 8 G. & E. Spur and Bevel Cutter.
- 1—24" Fellows Gear Shaper.
- 1—24" x 8" G. & E., for spur and bevel.
- 1—28" x 10" Cincinnati, spur gears only.
- 1—New 30" Flather, spur gears only.
- 3—36" Fellows Gear Shapers.
- 1—No. 3 Brown & Sharpe Auto. Gear Cutter, Spur.

GRINDERS—UNIVERSAL, FOR CUTTERS, DRILLS, REAMERS, ETC.

- 1—New Norton No. 1.
- 1—New Wilmarth & Morman, style B X.
- 1—No. 1 Cincinnati.
- 1—New Walker No. 2, outfit K (capacity 9" x 26").
- 8—No. 180 Wells.

GRINDING MACHINES—CYLINDRICAL—PLAIN

- 1—No. 11 (6" x 30") Brown & Sharpe.
- 1—6" x 48" Pratt & Whitney.
- 1—New No. 12 (8" x 26") Brown & Sharpe.
- 1—10" x 50" Norton.
- 1—New 10 x 72 Norton, plain.
- 1—No. 16 (10" x 72") Brown & Sharpe.
- 20—12" x 24" Modern, self-contained.
- 6—12" x 36" Modern, self-contained, motor or belt driven.
- 6—12" x 48" Modern, self-contained, motor or belt driven.
- 1—16" x 66" Landis, with crank grinding.
- 1—13 x 32 Landis, rebuilt.
- 1—18" x 96" Brown & Sharpe.
- 1—New 10" x 36" Landis. Immediate.

GRINDING MACHINES—CYLINDRICAL—UNIVERSAL

- 1—No. 1 Fraser, with surface grinding attachment.
- 1—No. 1 1/2 (10" x 30") Landis.
- 1—No. 2 1/2 (10" x 36") Bath.
- 1—No. 2 (9" x 20") Bath.
- 1—New No. 2 Bath.
- 1—No. 2 New Walker, 9" x 26".
- 1—10" x 42" Modern.
- 1—No. 2 (12" x 30") Brown & Sharpe.
- 1—New No. 2 Morse Cap. 12" x 30", universal, December delivery.
- 1—No. 3 (12" x 40") Brown & Sharpe.
- 1—12" x 42" Landis.

GRINDING MACHINES—INTERNAL

- 1—No. 1 1/2 Landis.
- 1—No. 70 Heald.
- 1—No. 75 Heald.

GRINDERS—CYLINDER

- 1—No. 27 Brown & Sharpe.
- 1—No. 60 Heald, single pulley drive.

GRINDERS—DISC

- 1—No. 14 Bealy.
- 1—New No. 17 Gardner (Pattern Makers).

GRINDING MACHINES—RING

- 1—No. 200 Heald.
- 1—No. 210 Heald.

GRINDING MACHINES—EDGE

- 1—No. 374 Safety Emery Wheel Co.

GRINDING MACHINES—SURFACE

- 1—No. 1 Diamond, capacity 12" x 12" x 24", automatic.
- 4—New No. 2 Reid (same as B. & S.).
- 1—22" x 12" x 60" Springfield, planer type, automatic.
- 1—New No. 1 Wilmarth & Morman.

GRINDING MACHINES—DUPLEX

- 1—No. 5 Bath, suitable for grinding cylinders, pistons, piston rings, etc., 16" feed, swivel table, water pump.

GRINDING MACHINES—FACE

- 1—Diamond Face Grinder, 4' travel, 14" wheels.

HAMMERS—POWER, FORGING

- 1—40-lb. Bradley Helve.
- 1—150-lb. Bradley Helve, upright.

HAMMERS—BOARD LIFT, DROP

- 1—400-lb. Billings & Spencer.
- 1—2000-lb. Chambersburg.

HAMMERS—STEAM, FORGING

- 1—New 600-lb. Bell.
- 1—New 3000-lb. Bell, September delivery.

KEYSEATERS

- 2—No. 0 Mitts & Merrill.
- 1—No. 2 Mitts & Merrill, motor driven.
- 1—60" stroke Compton-Knowles Broacher.
- 6—New 12 x 4 Shepard, reverse head.
- 8—New 12 x 5 Shepard, reverse head.
- 3—New 12 x 6 Shepard, reverse head.

LATHES—MANUFACTURING—NOT SCREW CUTTING

- 13—No. 3 X Reed-Prentice, semi-automatic.
- 14—Reed-Prentice Shell Lathes for 4" or 1 1/2-lb. American shells.
- 60—14" x 6" Reed Stud and Bolt.
- 5—16" x 8" Fairbanks-Morse, heavy duty.
- 70—New Simplex, 16" x 8".
- 14—16 x 8 Simplex, single pulley drive.
- 22—18" x 8" Battle Creek, heavy duty.
- 5—20" x 8" Merschon.
- 50—20" x 10" Hindman, high duty.
- 12—21" x 8" LeBlond, quick change, with attachment for grooving and facing both ends of shells, with air cylinders and mandrels for 5" shells.

LATHES—ENGINE

- 6—New 12 x 4 Shepard reverse head.
- 8—New 12 x 5 Shepard reverse head.
- 3—New 12 x 6 Shepard reverse head.
- 1—14" x 8" Bradford, taper attachment.
- 2—16" x 6" LeBlond, pan bed, quick change gears, taper attachment.
- 1—18" x 8" L. & S., geared head, taper.
- 1—18 x 10 Hendey, quick change gear, 14" chuck.
- 3—18" x 9" Chard.
- 1—New 19" x 8" LeBlond, heavy duty.
- 22—20" x 8" Lodge & Shipley, quick change gear.
- 7—New 20" x 8" American, heavy duty.
- 9—22" x 10" Putnam, oil pan, turrets.
- 4—24" x 10" Reed.
- 2—24" x 12" S. & B.
- 1—24" x 14" Lodge & Shipley, patent head.
- 4—24" x 14" American, quick change.
- 3—New 26" x 12" Boye & Emmes.
- 1—26" x 24" New Haven.
- 4—New 28" x 12" Boye & Emmes.
- 1—28" x 18" S. & B.
- 5—New 30" x 14" Boye & Emmes.
- 3—New 32" x 13" Pittsburgh pattern.
- 1—36" x 15" Fildeld, 36 x 16".
- 8—New 36" x 24" Putnam, triple geared.
- 1—38 x 19" Steptoe, single back gear.
- 1—24" x 45" x 22" McCabe, double spindle.
- 1—48 x 27" x 9" Betts, triple back gear.
- 1—60 x 27 Betts, triple back gear.
- 1—New 66" x 30" Putnam, December delivery.
- 1—71" x 20" Fildeld, triple geared.

LATHES—TURRET

- 5—2 x 24 Jones & Lamson.
- 5—3 x 36 Jones & Lamson.
- 18—6A Potter & Johnson.
- 2—21 Gisholt.

MILLING MACHINES—KNEE TYPE—UNIVERSAL

- 1—New No. 1 Kempamith.
- 1—No. 1 1/2 Hendey-Norton.
- 1—No. 2 Kempamith, back geared.
- 1—No. 2 New Cincinnati.
- 2—No. 2 1/2 LeBlond, September delivery.
- 2—No. 3-H LeBlond, September delivery.
- 1—No. 3 Cincinnati, single pulley drive, high power, vertical attachment.
- 1—New No. 4 LeBlond Heavy Duty. Immediate.

MILLING MACHINES—KNEE TYPE—PLAIN

- 1—No. 0 Pratt & Whitney.
- 3—New No. 1 Rockford.
- 2—New No. 1 Kempamith.
- 1—1/2 American.
- 1—New No. 2 Rockford.
- 1—No. 3 LeBlond.
- 1—No. 3 Cincinnati.
- 1—No. 4 Garvin.

MILLING MACHINES—VERTICAL

- 4—New No. 4 B Becker.
- 1—No. 2 New Cincinnati.
- 2—No. 5 Becker.

MILLING MACHINES—PLANNER TYPE

- 1—No. 2 Beaman-Smith.
- 2—Ingersoll Slab Millers, working surface of table 60" x 20".
- 1—No. 4 Beaman & Smith, vertical spindle, open side, working surface of table 120" x 24", removable housing on one side.

PLANERS

- 1—24" x 24" x 6" Gray, one head on cross rail.
- 1—26" x 26" x 8" Gray, one head on cross rail.
- 1—30" x 30" x 8" Gale Planer, one head.
- 1—30" x 30" x 8" Whitcomb, one head.
- 1—New 36" x 36" x 12" Powell, high speed, one head.
- 1—36" x 30" x 12" New Haven, one head.
- 1—36" x 36" x 9" Sellers, four heads.
- 1—36" x 36" x 9" Sellers, two heads.
- 2—New 36" x 36" x 12" Woodward & Powell, two heads on cross rail, one side head, October delivery.
- 1—36" x 36" x 14" Sellers, four heads.
- 1—42" x 10" Hewes & Phillips, one head on rail, one side head.
- 1—42" x 10" Hewes & Phillips, one head on 1—48 x 48" x 16" Sellers, one rail head, two side heads.
- 1—50" x 14" Powell, one head.
- 1—72" x 72" x 26" motor drive, Betts, four heads.

SCREW MACHINES AUTO.

- 3—No. 51 National Acme.
- 2—No. 52 National Acme.
- 2—No. 53 National Acme.

SHAPERS

- 1—New 16" Springfield.
- 1—16" Motor Driven, Rockford.
- 2—New 24" Milwaukee.
- 1—New Barker 24".
- 3—New 24" Steptoe. Back Gear.

Second Hand Machines

Four and one-half inch bar horizontal boring machine.
 20" Prentice Bros. lever feed drill.
 24" Sibley, sliding head drill, B.G., P.F.
 20" Hoefer three-spindle gang, B.G., P.F.
 20" Barnes four-spindle gang, one B.G., three P.F., one tapping.
 No. 413 Baker Bros. heavy pattern four-spindle gang.
 16" Brown & Sharpe spur and bevel gear cutter.
 26" Brown & Sharpe spur gear cutter.
 36" x 12" Gould & Eberhardt vertical cutting type spur gear cutter.
 12" x 24" Modern plain grinder, self-contained, fine condition.
 Landis universal grinder (small).
 No. 1 Baker Bros. keyseater.
 16" x 8" Bradford lathe, compound rest.
 21" x 10" Bradford lathe, compound rest.
 22" x 10" LeBlond lathe, compound rest, turret on carriage.
 56" x 56" x 26" Bement planer, four heads.
 1-1/2" x 9" Acme wire feed screw machine, power feed turret.
 34" Lodge & Davis shaper.

Marshall & Huschart Machinery Co.

17 S. Jefferson St. 915 Chemical Bldg.
 CHICAGO, ILL. ST. LOUIS, MO.

Immediate Delivery

24" x 10' Springfield Engine Lathe.
 9" x 4' Star Engine Lathe.
 No. 1/2 AVEY High-speed Ball-Bearing Sens. Drills.
 No. 1 BAKER BROS. High-Speed Drill.
 12" x 32" LANDIS Plain Grinder.
 No. 3 GARVIN Cutter and Surface Grinder.
 10" x 50" Norton Plain Grinder.
 36" Bickford Plain Radial.
 3" Stover Pipe Machine.
 2 1/4" x 24" WARNER & SWASEY Hollow Hexagon Turret Lathe.
 No. 6 Warner & Swasey Turret Screw Machines.
 3 1/2" Prentice Bros. Plain Radial.
 4" Mueller Plain Radial.
 7" OHL Bending Brake.
 No. 2 BATH Universal Grinder, 9" x 20".
 No. 2 COCHRANE-BLY Die Filing Machine.
 7/8" FOSTER-KIMBALL Plain Head Screw Machine.
 No. 11 1/2 HIGLEY Cold Saw.
 16" Barker Crank Shaper.
 No. 3 Barber-Colman Gear Hobbing Machine.
 5/8" CLEVELAND Automatic Screw Machines (2).

THE E. L. ESSLEY MACHINERY CO.

551-557 West Washington Boulevard
 CHICAGO, ILLINOIS

Factory and Mill Supply Co.

137 Oliver Street, BOSTON, MASS.

One Bausch Plain Radial Drill, 6' arm, cone driven.
 One Bickford Radial Drill, with tapping attachment, 3' arm, single pulley drive.
 Two Pratt & Whitney Plain Cylindrical Grinders, capacity 6" x 48", in excellent condition.
 One Springfield Machine Tool Co., Cylindrical Grinder, capacity 12" x 96".
 One Flather Automatic Spur Gear Cutter, capacity 26" x 8', excellent condition.
 One Brown & Sharpe, ditto.
 One 8" x 18" Modern Tool Co., Grinder, new.
 One Diamond Machine Co., Roll Grinder, capacity 8" x 26".
 One No. 5 Becker Vertical Milling Machine.
 One Kempsmith No. 1 Universal Milling Machine.
 One No. 3 Cincinnati Plain Milling Machine.
 One 26" x 7' Niles Planer, parallel drive, one head.
 One Wheeler Planer, 24" x 24" x 6' in excellent condition.
 One Whitcomb Crank Planer, used less than two years, excellent condition.
 One Hendey 28" Friction Shaper, motor driven, complete with motor, practically new.
 One 2" x 24" Jones & Lamson Geared Head Turret Lathe, with bar and chucking equipment.
 One 2" x 24" Jones & Lamson Geared Head Turret Lathe, flat, two spindle, with complete chucking equipment, latest model, in excellent condition.
 We also carry a large line of Shapers, Turret Lathes, Hand Screw Machines, Engine Lathes, Upright Drills, etc. Send us your inquiries.

WANTED AT ONCE

the following machines for export to Japan. Must be in first-class condition and subject to acceptance after inspection:

10—Radial Drills, 5' or over. Give reach of arm.
 6—Slotters over 18".
 4—Horizontal Boring.
 8—Planers 48 x 48 or over. Give length of bed.
 30—Lathes, 48" or over. Give length of bed.
 3—Lathes, 60" or over.
 20—Upright Drills, 2" capacity.
 5—Boring Mills over 7".
 1—Boring Mill, 10".
 1—Boring Mill, 12".
 1—Boring Mill, 42".
 1—Bending Roll for 1-1/2" material 13' wide.
 1—Bending Roll for 1-1/2" material 8' wide.
 1—Straightening Roll for 1-1/2" material 8' wide.
 1—Punch and Shear for punching 1-3/4" hole in material, 1-1/2" thick, 36" gap.
 1—Manhole Flanging Press for 1-1/2" material.
 1—2000-ton Steam Hydraulic Press.
 3—6" Universal Radial Drills.
 PAYMENT CASH AGAINST SHIPPING DOCUMENTS—STATE FULLY MAKE, AGE AND CONDITION.
 ALSO—6 Miles 40-lb. Rails and 5 Miles 30-lb. Rails, complete with splice bars and bolts. Second Hand; shipment in July.

BOX A138

Care MACHINERY, 148 Lafayette Street, N. Y.

ROUX & HEYBERGER

180 Rue Lafayette, Paris

Solicit Offers for

Seamless Steel Tubes.

Lap Welded Boiler and Steam Tubes.

MACHINE TOOLS

Draw Benches for Tubes.

Presses.

Forging Machines for Nuts, Bolts and Rivets.

PUNCHING and SHEARING MACHINERY

Radial Drills.

Steel and Iron Products.

MODERN GRINDER

Plain Cylindrical, Self Contained 12" x 36"

Used less than 10 days. Same as brand new machine. No use for it here, so offer to help someone else. First come first gets it. A great bargain for quick sale.

W. B. MARVIN MFG. CO.

URBANA, OHIO

WANTED

Steam Driven Air Compressor

about 1,000 cu. ft., two stage. 90 to 100 pounds pressure, for 125 pounds boiler pressure. Non-condensing.

DRIVER-HARRIS CO.

NEWARK, N. J.

3/4" GRIDLEY

Four Spindle Screw Machine, absolutely new —price \$1500.

Nearly new Brass Tube Polishing Machine — price \$500 for prompt acceptance.

STANDARD METAL MFG. CO.

NEWARK, N. J.

BOARD DROP HAMMERS

We offer subject to previous sale

2—Chambersburg 2000-lb. Model 20-BH

3—E. W. Bliss 800-lb. Model 1-2100

1—Billings & Spencer 400-lb. Model D

All are in good condition. B. & S. practically new. Space required for other equipment.

The Union Switch & Signal Co.
 SWISSVALE, PA.

REBUILT TOOLS

GRINDERS: No. 1 Landis universal, 8" x 20".
 Landis Crank Grinder, 16" x 66", with plain and crank heads.

TURRET LATHES: Jones & Lamson, 3" x 36", geared sliding head, bar equipment.
 Pond 21" Rigid, geared head Hamilton, 20" x 8", engine turret, friction head, pan bed, p. f. turret on bed.

GEAR CUTTERS: 22" x 5" x 6 pitch, Gould & Eberhardt, spur and bevel.
 Whiton, 24", spur gears only

MILLING MACHINES: No. 1-1/2 Grand Rapids, back geared, plain.

No. 13 Brown & Sharpe Manufacturing, plain.

No. 3 Aurora, plain, single sliding gear.

No. 1-1/2 American, universal, complete.

4-spindle Warner & Swasey Valve Miller.

PLANER: 42" x 42" x 10' Hewes & Phillips, one rail head, one side head, fine.

SEND FOR COMPLETE LIST

FEDERAL MACHINERY SALES CO.

14 N. Jefferson Street, CHICAGO

REBUILT MACHINES

PLANERS

- 1—Sellers 36 x 36 x 10' with 2 heads.
- 5—Sellers 25 x 25 x 6'.
- 2—Sellers 25 x 25 x 8'.
- 1—Putnam 24 x 24 x 8'6.
- 1—Putnam 25 x 25 x 10'.
- 1—Wheeler Heavy 30 x 30 x 8'6.
- 1—Lathes-Morse 24 x 24 x 5'6.
- 1—New Haven 24 x 24 x 7'.
- 1—Wood Light 30 x 30 x 8'.
- 1—Putnam 42 x 40 x 12'6.

GRINDERS

- 1—LeBlond Universal Tool & Cutter, power feed, same as new.
- 1—Bridgeport Plain Grinder, 16 x 36.
- 1—No. 1 Landis Universal Grinder.
- 1—No. 3 Landis Universal Grinder.
- 2—No. 6X Diamond Double Disc Grinders.
- 1—Ford-Smith Plain Grinder.

AUTOMATICS

- 1—1" National Acme Double Belt Type.
- 1—1 1/4" National Acme Double Belt Type.
- 1—No. 55 National Acme.
- 1—1" National Acme four-spindle.
- 2—No. 54 National Acme four-spindle.
- 3—2" Cleveland.
- 1—2 1/4" Cleveland.
- 2—2 1/4" Gridley Single-spindle Motors.
- 1—3 1/4" Gridley Single-spindle Motor.

LATHES

- 1—32 x 12' Draper Lathe, C.R., H.S.
- 1—36 x 22' Fitchburg Lathe, C.R., P.C.F.
- 1—30 x 8' Fitchburg, C.R., P.C.F.
- 3—16 x 8' Putnam, C.R., taper.
- 6—18 x 8' Porter, C.R., semi-quick, taper.
- 2—18 x 8' Davis, C.R., pan, pump, taper.
- 10—16 x 8' Greaves-Klusman, C.R., pan, pump.
- 9—20 x 6' Perkins Plain Turning, pan, pump.
- 1—14 x 6' Porter, C.R.
- 1—20 x 8' LeBlond, C.R.
- 1—13 x 5' Seneca Falls, C.R., pan.
- 14—20 x 6' Perkins Lathes, pan bed, chuck, Fay & Scott turrets.

MISCELLANEOUS

- 1—No. 3 Kempsmith Plain Miller, same as new.
- 1—9" Industrial Works Slotter.
- 1—24" Aurora Sliding Head Back Geared Drill.
- 3—Prentice 24" Sliding Head Drills.
- 2—Industrial 40" Drills.
- 1—Western Hydraulic Banding Machine.
- 1—Jenckes Band Turning Lathe, with 3" Universal Chuck.
- 1—36" Aurora Drill.
- 1—12" Bement Travelling Head Shaper.
- 1—12" Juengst Crank Shaper.
- 1—90" Putnam Wheel Lathe, double quartering.
- 1—Sellers Slab Miller, 24 x 21 x 12'.
- 1—No. 21 Lea-Simplex Saw.
- 1—E6 x 10 Cincinnati Gear Cutter.

This is only a Partial List—Send for Full List.

SIMMONS MACHINE CO., Inc.

New York: 1001 Singer Building
Telephone Cortlandt 6575

Albany, N. Y.: 987 Broadway
Telephone 4876 Main



Niles 42" Vertical Boring Mill. One Swivel Head. One Fixed Turret Head. Four Jaw Chuck Table. Self-contained.

Fellows 36" Gear Shaper.

Bardons & Oliver No. 5 Screw Machine.

Jones & Lamson 2" x 24" Flat Turret Lathe. Geared Head.

Warner & Swasey No. 2-A Hexagon Turret Lathe. Cone Drive.

Greenfield No. 1 Plain Grinder, 5" x 12". Hydraulic Table Feed. Landis No. 24 Plain Grinder, 12" x 66".

HILL, CLARKE & CO., Inc.
THE MACHINERY MERCHANTS

156 Oliver Street, BOSTON

136 Cedar Street, NEW YORK

List of Machinery for Disposal
On hand at Hudson Motor Car Plant

Prices are all f.o.b. Detroit—sale terms, one-third cash with order, balance to be paid against sight draft attached to bill of lading.

- 1—14" Fay Automatic Lathe, 14" swing over-shears and 10" under-carriage, turn to 10" in length, with equalizing drive face plate, self-contained taper attachment, oil pump, piping and change gears. (Practically new.)
- 1—19" x 8' LeBlond Heavy Duty Lathe, complete with countershaft, etc. (Never been used.)
- 7—19" x 6' LeBlond Heavy Duty Automobile Lathes, complete with turret tool posts. (Absolutely new.)
- 1—12-spindle Foote-Burt Valve Grinder. (Practically new.)
- 1—99 Defiance Bow Chucking Machine, complete with counter belt, shifting apparatus, 2 chucking heads, knives, guards, 1 cast iron master cam and necessary oil cups and wrenches. (Very little service.)
- 1—No. 598 Bow Shaping and Equalizing Machine, complete with all standard equipment. (Practically new.)
- 2—Bryant Chucking Grinders No. 6—one new and one used.
- 1—Bryant Chucking Grinder—double spindle. (New.)
- 1 Serial No. 16-249 Gisholt Lathe.
Diam. of chuck, 24".
Width of belt, 4".
Length overall, 11' 4".
Width overall, 3' 10".
Shipping weight (approx.) 8000 lb.
Swing over carriage, 24".
Swing over ways, 13 3/4".
H. P. motor for main drive 4 1/2.
H.P. motor, turret rapid traverse 1.
Bore of spindle, 2 1/2".
Diam. of holes in turret, 3".
(This machine has been in use about a year and is in excellent condition.)
- 1—No. 6-K Disc Grinder, manufactured by Diamond Machine Co., Serial No. 5125. (Slightly used.)
- 1—No. 4 Gardner Disc Grinder. (Slightly used.)
- 1—2 x 8 Barnes Horizontal Drill, double spindle. (In excellent condition.)

HUDSON MOTOR CAR CO., Detroit, Mich.

M. J. WALSH MACHINERY CO.
141 Sycamore St., Milwaukee, Wisconsin
Second-Hand Machines

LATHES

- 1—18" x 10' Rahn-Meyers Lathe, 5-step cone, single back gear, compound and steady rest, hollow spindle, power cross feed, chuck fitted countershaft.
- 1—16" x 8' Porter Lathe, 4-step cone, single back gear, compound and steady rest, power cross feed, countershaft.
- 2—No. 6 Warner & Swasey Screw Machines geared friction head, power feed to the turret.
- 1—No. 2A Warner & Swasey Lathe with bar equipment.
- 1—14 x 6 Hamilton Style A Lathe oil pan, taper attachment and relieving and tapping attachments.
- 1—11" x 5' Pratt & Whitney Lathe, 5-step cone, single back gear, plain rest, countershaft.
- 1—20" Porter Pattern Maker's Lathe, countershaft.
- 2—No. 6 Potter & Johnston Automatic Chucking Lathes, with all regular equipment regularly furnished for chucking.
- 1—3 x 36 All Geared Head Jones & Lamson Turret Lathe, with bar equipment, friction feed.

DRILLS

- 1—14"—4 Spindle Henry & Wright Ball Bearing Drill.
- 1—Small Knight Drilling Machine and for Milling.
- 1—20"—2 Spindle W. F. & J. Barnes Drill. One spindle arranged with wheel, lever and power feed. Other spindle with wheel, lever and power feed, back gears and tapping attachment. Both drills are the same.
- 1—24" All Geared Drive Barnes Drill.

PUNCH PRESSES

- 1—No. 19 Bliss Open Back Inclined Press, with stationary legs, automatic feed, back geared.
- 1—No. 3A Willard Oper Back Inclined Press.
- 1—No. 1 Solid Back Heartley Press.
- 1—No. 472 Consolidated Double Crank Press, with 4 stroke.
- 1—Walsh Hand Screw Press.
- 1—Perkins Screw Press.

GRINDERS

- 1—16 x 60 Landis Plain Grinder with two sets of heads. One for plain cylindrical grinding. Other for crank grinding.
- 1—12 x 36 Cincinnati Plain Grinder Self Contained Counter.
- 1—No. 1 Landis Universal Grinder.
- 1—8 x 16 Ott Plain Grinder.

MISCELLANEOUS IRONWORKING MACHINES

- 1—No. 1 1/2 Grand Rapids Back Geared Plain Mfg. Milling Machine.
- 1—Kempsmith Lincoln Type Milling Machine.
- 1—Four Spindle Warner & Swasey Valve Milling Machine, fitted with No. 2 M.E.C. valve milling air chuck, countershaft.
- 1—Racine Power Hack Saw No. 1.
- 1—Circle Shears.
- 1—62" Berth Foot Power Gap Squaring Shears.
- 1—50" Peck, Stow & Wilcox Cornice Brake.
- 1—10" Dreis & Krump Bending Brake.
- 1—4" Peck Stow and Wilcox Roll, 4" diameter rolls.
- 1—7" Roll, 6 1/2" Rolls.
- 1—20" Whiton Gear Cutter.
- 1—1 1/2" Acme Bolt Cutter.
- 1—American Oil Separator.
- 1—No. 94 Forbes Pipe Machine, for hand and power, cuts off and threads from 2 1/2" to 6" inclusive.
- 1—No. 119 Bliss Thread Roller.
- 1—Peerless Combination Punch and Shear.
- 1—1/2" Shuster Riveter.
- 1—1/2" Shuster Riveter.
- 1—Bliss Deep Throat Punch and Riveting Machine.



RIVERSIDE MACHINERY LIST

WE OWN EVERY TOOL OFFERED

ENGINE LATHES

- 1—28 x 10 Hamilton Standard Engine Lathe, with turret.
- 1—28 x 15 Putnam Standard Engine Lathe.
- 1—22 x 14 Putnam Standard Engine Lathe.
- 3—New 18 x 8 Springfield Engine Lathes.
- 1—New 16 x 8 Springfield Engine Lathe.
- 1—New 14 x 6 Springfield Engine Lathe.
- 1—18 x 6 Jones & Lamson Standard Engine Lathe.
- 1—16 x 8 Porter Standard Engine Lathe.
- 2—16 x 8 Reed Stud Lathes.
- 1—14 x 8 Sebastian Standard Engine Lathe.
- 1—14 x 6 Lodge & Shipley Engine Lathe.
- 1—14 x 6 Springfield Engine Lathe.
- 1—14 x 6 Prentiss Engine Lathe.
- 1—14 x 6 Sebastian Engine Lathe.
- 2—14 x 6 Van Werk Engine Lathes.
- 1—11 x 5 Seneca Falls Engine Lathe.
- 1—No. 3 Harding Bench Lathe.

TURRET AND SCREW MACHINES

- 1—2 1/4 x 24 Jones & Lamson Flat Turret Lathe, S.G.H.
- 1—2 x 24 Jones & Lamson Flat Turret Lathe, cone head.
- 2—No. 6-A Potter & Johnson Automatic Lathes.
- 3—No. 4 Foster F.G.H. Hand Screw Machines.
- 2—No. 3 Foster F.G.H. Hand Screw Machines.
- 1—No. 5 Pierson F.G.H. Hand Screw Machine.
- 1—No. 4 Smurr & Kamen Hand Screw Machine.
- 4—New 14" Pierce Turret Lathes.
- 2—New 1 x 8 Pierce Hand Screw Machines.
- 2—2" Cleveland Automatic Screw Machines, jogger feed.

MILLING MACHINES AND GRINDERS

- 2—No. 3 Cincinnati Universal Cone Type.
- 5—No. 1 1/2 Knight Milling and Drilling Machines.
- 2—No. 13 Pratt & Whitney Lincoln Type Milling Machines.
- 1—No. 1 Cincinnati Plain Milling Machine.
- 1—No. 13 1/2 Garvin Plain Milling Machine.
- 1—No. 2 Hendey Plain Milling Machine.
- 3—Fox Hand Milling Machines.
- 1—Garvin Hand Miller.
- 1—No. 2 1/2 Bath Universal Grinder.
- 1—No. 170 Wells Cutter Grinder.
- 1—Mina Valley Universal Cutter Grinder.
- 4—No. 0 Burke Bench Mills. (New.)

We also carry a large stock of Steam Engines, Steam Pumps and Electrical Equipment of all kinds.
We are in the market to purchase machine tools, both large and small.

DRILL PRESSES

- 1—3-spindle 8" Overhang Henry & Wright High Speed Drill.
- 3—12" Leland & Gifford High Speed Bench Drills.
- 5—20" Buffalo Plain Drill Presses.
- 4—6 spindle Fox High Speed Drill Presses.
- 2—4 spindle Fox High Speed Drill Presses.
- 1—3' Mueller Plain Radial Drill.
- 1—4' Bickford Radial Drill with T.A.
- 1—6' Mueller Plain Radial Drill.
- 1—16 spindle Natco Drill.

SHAPERS AND PLANERS

- 1—24" Ohio H.D. B.G. Crank Shaper.
- 1—24" New Barker Crank Shaper.
- 1—24" Lodge & Davis Geared Shaper.
- 1—18" Hendey Geared Shaper.
- 1—16" Hendey Geared Shaper.
- 1—16" Garvin Shaper.
- 2—16" New Springfield B.G. Crank Shapers.

PRESSES

- 1—Waterbury-Farrell Straight Sided Geared Press with double cam knock-out.
- 1—No. 10 Perkins Drawing Press.
- 5—No. 2-W Bliss Wiring Presses.
- 1—800-lb. B. & S. Roll Board Hammer.
- 1—800-lb. P. & W. Roll Board Hammer.
- 1—50-lb. Scranton Belt Hammer.
- 1—25-lb. Bradley Helve Hammer.

AIR COMPRESSORS

- 1—8 x 6 Westinghouse Steam Air Compressor.
- 1—16 x 18 x 12 Union Steam Pump Co., Steam Driven Air Compressor.
- 1—10 x 10 Ingersoll Sargent Belt Driven Air Compressor.
- 1—10 x 10 Clayton Belt Driven Air Compressor.
- 1—8 x 8 Fairbanks Morse Electrical Driven Air Compressor.
- 1—8 x 8 Gardner Single Belt Driven Air Compressor.
- 1—8 x 8 Union Steam Pump Co. Belt Driven Air Compressor.
- 1—7 1/2 x 6 Chicago Pneumatic Tool Co. Belt Driven Air Compressor.
- 1—6 x 6 Chicago Pneumatic Tool Co. Belt Driven Air Compressor.

RIVERSIDE MACHINERY DEPOT, 17-29 St. Aubin Ave., Detroit, Mich.

SECOND-HAND MACHINERY FOR SALE BY THE MOTCH & MERRYWEATHER MACHINERY COMPANY

711 Lakeside Ave., N.W.

Cleveland, Ohio

Branch Offices: Detroit, Cincinnati, Pittsburgh.

AUTOMATICS

- 2" Cleveland.
- No. 22 New Britain Chucking.
- No. 23 New Britain Chucking.
- No. 33 New Britain Chucking.

BROACHING MACHINES

- No. 1 J. N. Lapointe.
- No. 2 Lapointe Machine Tool Co.
- No. 3 Lapointe Machine Tool Co.

DRILLING MACHINES

- 15" Barnes.
- 10" Burke Sensitive.
- Four-spindle 26" Hoefer Gang.
- Four-spindle No. 1 1/2 Foote-Burt Rail.
- Four-spindle No. 2 Avey.
- Two-spindle No. 2 Avey.

GRINDERS

- 6" x 32" Norton.
- 10" x 50" Norton.
- 10" x 30" Landis.
- No. 1 Cincinnati Cutter.
- No. 2 Brown & Sharpe, universal.
- No. 2 1/2 Bath, universal.
- No. 3 Oesterlein.
- No. 12 Gardner, duplex disc.
- 24" Double Wet Tool.
- 20 x 1 1/2 Single Wet Tool.
- No. 200 Heald, ring.

HAMMERS

- 35-lb. Williams & White, power tire welding.
- No. 3 Standard 300-lb. belt drop.
- 1200-lb. Bell steam.

KEYSEATERS

- No. 1 Davis.
- No. 2 Mitts & Merrill.
- 18" x 1 1/2" Norton.

LATHES

- 14" x 6' Sebastian.
- 14" x 6' Reed Extra Heavy Stud.
- 16" x 8' Walcott.
- 16" x 8' Reed Stud.
- 16" x 6' Harrington.
- 16" x 10' Rahn-Carpenter.
- 18" x 8' Lodge & Shipley.
- Three step cone, D.B.G.
- 18" x 8' Lodge & Shipley, Pt. Hd.
- 18" x 8' LeBlond.
- 18" x 8' Bradford.
- 18" x 8' Walcott Q. C.
- 18" x 10' Monarch Q. C.
- 18" x 12' Monarch Q. C.
- 20" x 8' Walcott Q. C.
- 30" x 14' Lodge & Shipley.

MILLING MACHINES

- No. 2 Oesterlein.
- No. 7-H Becker, Lincoln Type.
- No. 00 Brown & Sharpe.

No. 8 Pratt & Whitney, hand.

No. 10 Pratt & Whitney, hand.

PLANERS

- 24" x 24" x 5' Blaisdell, one head.
- 26" x 26" x 6' Pond.
- 36" x 36" x 10' Sellers, 4 heads.

PIPE MACHINES

- 12" Curtis & Curtis.

PRESSES

- No. 2 Consolidated plain inclinable.
- No. 5 Stiles & Parke Blanking Press.

SAWS

- 6" Atkins "Kwick-Kut."
- 7" High Duty Paragon.

SCREW MACHINES

- 1 1/2" Foster, motor drive.
- 1 1/2" Warner & Swasey.
- 4 1/2" Bardons & Oliver.

SLOTTERS

- 12" Industrial.

TURRET LATHES

- 2" Jones & Lamson.
- 14" Warner & Swasey.
- 16" Bardons & Oliver.
- 21" Gisholt.
- 22" Libbey.
- 24" Gisholt.

MISCELLANEOUS

- Flywheel balancing machine, Rockford.
- Oil Separator, Curtis.

USED MACHINERY FOR SALE**SCREW MACHINES**

- 4—No. 55 National Acme Automatics, 1½" capacity, 4-spindle, new within 6 months.
- 2—Universal Automatics, ¾" capacity, 5-spindle.
- 1—2" Cleveland Automatic.
- 1—1¾" Spencer Double End Automatic.
- 1—1" Pratt & Whitney Automatic.
- 1—Meridan Tool 2¼" Hand Screw Machine, wire feed and auto. chuck, back geared.

TURRET LATHES

- 1—Pratt & Whitney No. 3, 2" capacity with drawn collets, back geared, oil pump and pan, power feed turret.

MISCELLANEOUS TOOLS

- 1—Brainerd Plain Miller, No. 4½.
- 2—Geometric Threading Machines, fitted with self-opening heads, ¾" dies, new within 6 months.

THE PUFFER MFG. CO., Winchester, Mass.

34 to 42 INCH BORING MILLS**FOR PROMPT DELIVERY**

to be used on War Department production.
Urgently needed. Reply to

THE WEST STEEL CASTING CO., Cleveland, Ohio

FOR SALE**ENGINE LATHES****FOR IMMEDIATE DELIVERY**

- 20—16" x 6', 8' and 10', full quick change gear.
- 8—20 x 10' Engine Lathes.
- 9—16 x 6' Toolroom Lathes with full equipment.

Prices right—act quickly—for further particulars and printed matter address

THE CLEVELAND MACHINERY & SUPPLY CO., Cleveland, O.

FOR SALE

Large quantity of cast iron, steel split, wood pulleys and hangers. All in good condition and can be inspected at any time. Address, Purchasing Dept.

ROBERT GAIR COMPANY, Brooklyn, N.Y.

20-Ton Forcing Press and Roller Jaw Drill Chucks

Manufactured by

WEAVER MANUFACTURING CO.
SPRINGFIELD, ILLINOIS

IDEAL!

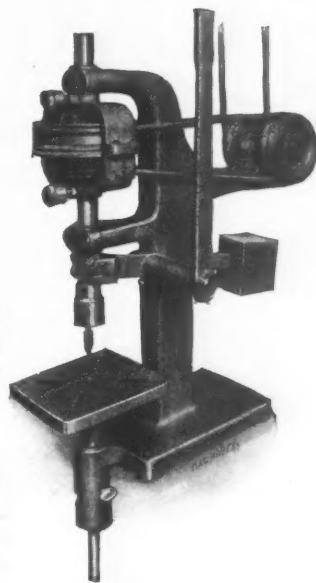
Price \$2.50

30 Days' Free Trial

Light, well constructed and durable—easily operated, easily read (from either side without adjustment) and easily poked into odd corners and small un-get-at-able places, the **IDEAL UNIVERSAL TESTING INDICATOR** is absolutely reliable for testing the accuracy of machine, instrument and tool work to thousandths.

You can't afford to be without it. Write for details—your dealer or direct.

JOHNSON & MILLER, 42 Murray St., New York

The "FULTON" Drills or Taps

It performs either operation fast and economically. Capacity up to ¾" holes.

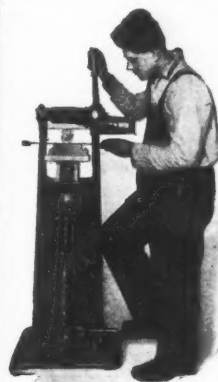
Has positive drive for drilling; two speeds for either drilling or tapping; friction pulleys are carried on ball bearings; control by hand or foot; capacity to drill 7/32 inch hole through one inch brass in eight seconds. Vertical, horizontal and attachment types.

Ask for complete description.

FULTON FOUNDRY & MACHINE CO.

25 Furman Street

Brooklyn, N. Y.

**MARKING**

Can Be Done at a Minimum of Time and Cost With the

Martin

No. 6 Hand Marking Machine

Unsurpassed for the marking of Trade, Name, Size or Patent Marks on all round or flat surfaces of tools or work of any description suitable for impressions.

Write for Complete Description

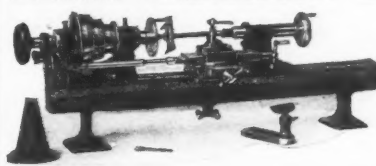
Martin Machine Co.

"The Marking Machine People"

We manufacture both Hand and Power Machines

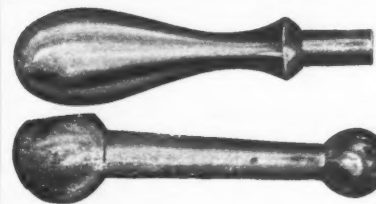
GREENFIELD

MASS., U. S. A.

ELGIN PRECISION BENCH LATHE

Superior in design and workmanship. Especially adapted to the tool-room, laboratory and experimental shop for all classes of tool, die, gauge and light manufacturing.

Catalogue upon request
THE ELGIN TOOL WORKS
ELGIN, ILLINOIS

**COMPARE**

with your present Handle costs our prices for Ball Cranks and Machine Handles of every description, from bar steel. Accurate, highly finished, complete in every detail and ready to attach.

The Cincinnati Ball Crank Co.
Cincinnati, Ohio
Successors to this department of the Schacht Mfg. Co.

CONTRACT WORK

SPECIAL PARTS, TOOLS and MACHINERY



Carroll Final Inspection—The Seal of Accuracy

The final checking-up on a Carroll-built tool or machine marks the culmination of a step-by-step inspection that makes it absolutely impossible for anything except "just right" to get through—it's the seal of absolute accuracy.

Maybe you need some special machinery or tools, or there's a production problem in your plant causing trouble. Let us show you what our service means. We'd welcome the chance to tackle your toughest proposition.

THE CARROLL ENGINEERING CO., Dayton, Ohio

JIGS—DIES—TOOLS

SPECIAL MACHINERY

Designed around practical application of the Golden Rule—"chuck-full" of the same high quality you'd incorporate if you were making your own. A trial order solicited.

STEINER BROS. - - Lima, Ohio

Phone: Lake 3212

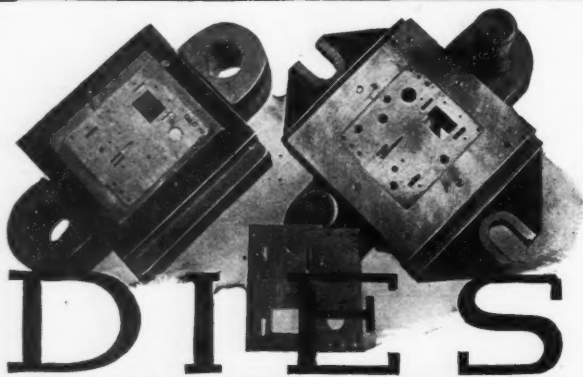
Let Us Make Your Tools or Specialties

We want orders to manufacture small, irregular parts such as used in rifle and gun work, or complete specialties.

Complete equipment of milling machines, profilers, drills, slotters, etc. In our tool room we have lathes, milling machines, grinding equipment, hardening furnaces, to make tools, fixtures, gauges, jigs, dies, etc.

Our Engineering Department will develop and chart manufacture operations of new inventions.

A. H. FOX GUN CO., Philadelphia.



It pays to use Nelson Dies. Highest grade workmanship. Prices right. Consult us.

NELSON TOOL COMPANY, Inc.
781-783 East 142nd St. New York City

The Metal Specialty Manufacturing Co. WATERBURY, CONN.

Bearing — **BALLS** — Brass
Burnishing — Copper

Standard — **RIVETS** — Special

Gloves — **SNAP FASTENERS** — Boxes

Quotations on request



CONTRACT WORK

327



Largest and best
equipped Fac-
tory in the World
for manufactur-
ing Automatic
TOBACCO
MACHINERY



OUR NEW PLANT

Also builders of
high grade spe-
cial and automat-
ic Machinery,
Jigs, Tools,
Gauges and
♦ ♦ Fixtures ♦ ♦

AMERICAN MACHINE & FOUNDRY COMPANY

Main Office and Factory: 5520 Second Avenue, Brooklyn, New York :: :: New York Office: 511 Fifth Avenue, New York

GAGES

ALL KINDS - ONE QUALITY

The paramount objective in Marvin manufacture is accuracy—not in a comparative degree, but to the very closest possible limits—whatever your requirements may be.

Everything Checked by
JOHANNSON BLOCKS

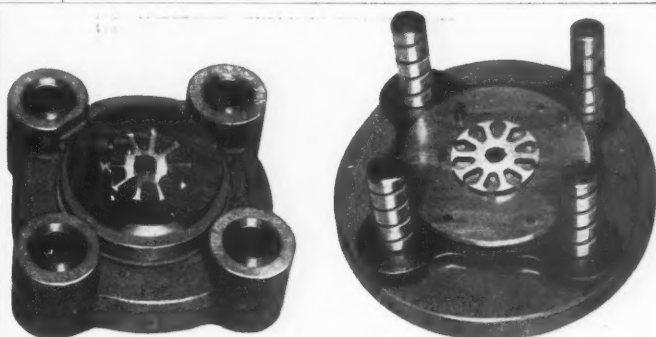
Modern methods followed, competent workmen employed, the best of material incorporated.

A trial order means
we make a new friend.



Let us hear from you.

W. B. MARVIN MFG. CO.
URBANA OHIO



A "Taylor-Shantz" Single Piece Armature Die

To make an armature die is not a difficult operation—but to make one 2 1/4" diameter, the Taylor-Shantz way, from a single piece of steel, to limits of 0.0005" in accuracy, to harden it properly and give it long life, is unusual.

We make many dies for many concerns. We can make them for you as well—and can show good reasons why we should.

Write us.

TAYLOR-SHANTZ COMPANY

Rochester, N. Y.

**25
Years of
Service**

Dies,
Tools,
Gauges,
Fixtures,
Special
Machine
and
Instrument
Work

For Value Received

Tool makers do not prosper in business for 25 years unless they make good tools—their reputation is based on the value of their tool service.

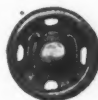
Guaranteed quality, accurate finish and fair treatment of customers have made our reputation—the reputation on which we base our application for your patronage.

Send Specifications for Estimate

THE J. C. ULMER CO.
CLEVELAND OHIO

Automat
TOOL WORKS

**Dies, Gages, Jigs, Fixtures
Special Machinery
Prompt Deliveries**



Snap Fastener Tools a Specialty

252-254 Greenwich Street
New York City
Telephone Barclay 7769



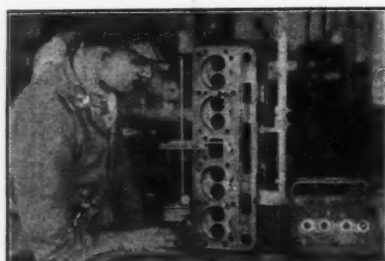
SP

SP

Tool Work Wood Patterns Machine Attachments



If a competent organization, adequate equipment and the ability to give real service are reasons why any concern should have your orders along this line, we'll have your business eventually. We'll get it "right now" if you'll just let us show you a sample of our work. Tell us what you need—jigs, fixtures, special machine attachments, wood or metal patterns, model work—anything in this field, and we'll gladly give you every assistance. As specialists in our line we're capable of meeting your requirements in this respect in a thoroughly practical, dependable manner. Will we hear from you?



THE S-P MANUFACTURING CO.
CLEVELAND OHIO, U. S. A.

SP

SP

J. MAUTE & SONS

23 KANE STREET, BUFFALO, N. Y.

MANUFACTURERS OF

Double Action Cut and Draw, Blanking, Forming,
Drawing, Combination, Reducing and Perforating

DIES TOOLS AND JIGS

Use Our Make of Dies for Good Results in Difficult
Drawing and Reducing.

LONG EXPERIENCE .. CONSULT US

Can You Contract for Boring Mill Work?

We have contract to place for prompt
machining of 10,000 cast steel wheels,
30 inches in diameter, for use on War
Department motor trucks.

Communicate with us quickly.

THE WEST STEEL CASTING CO.
CLEVELAND, OHIO, U. S. A.



TRY US
for Your
Screw Product Contract Work

Send Blue Prints for Quotations.
Prompt Deliveries Our Hobby

$\frac{1}{2}$ " to $2\frac{1}{2}$ " Capacity.

The Toledo Screw Products Co.
TOLEDO, OHIO

PHILADELPHIA FACTORY—

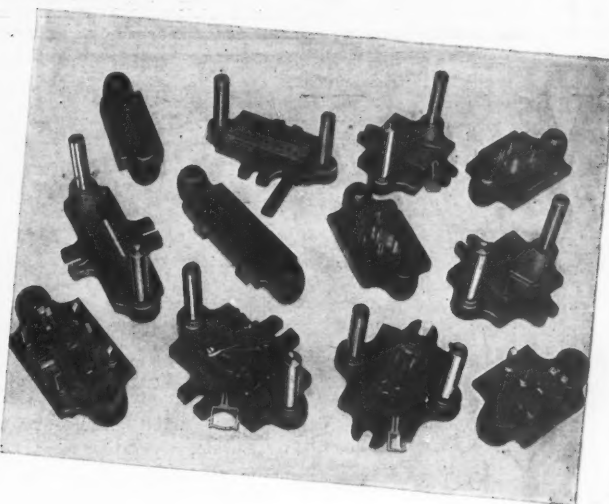
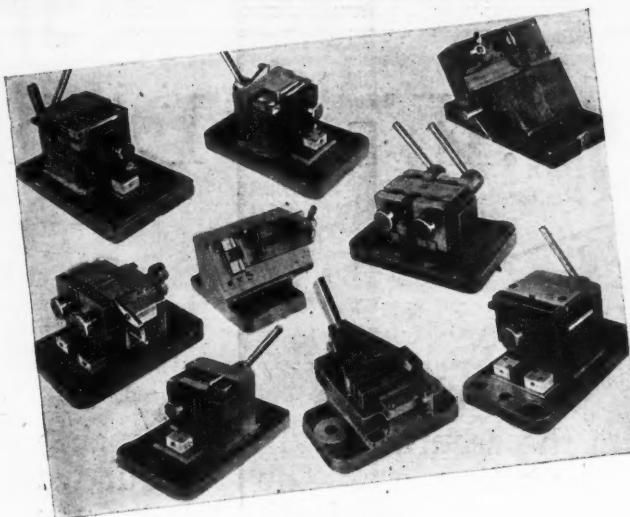
wants orders to manufacture small irregular parts such as required
in rifle and gun making.
We have milling machines, profilers, drills, slotters. Also complete
tool room equipment; lathes, milling machines, grinders,
hardening furnaces, etc.
Let us figure on your order for tools, complete specialties, or the
development and manufacture of new inventions.

Box A126, care Machinery, 148 Lafayette St., N. Y.

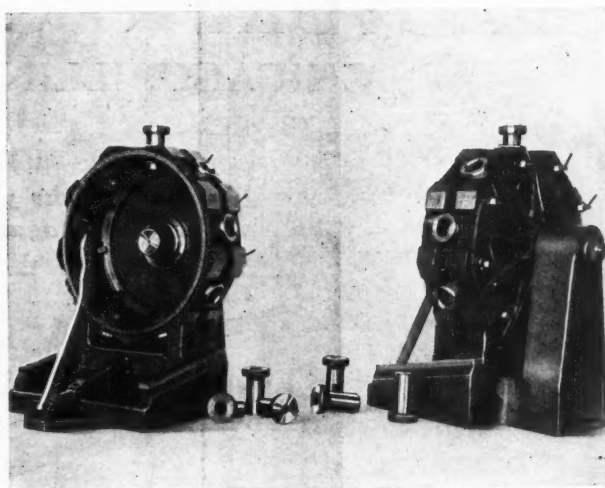
TOOLS, JIGS, DIES

STAMPINGS LIGHT MANUFACTURING

AMERICAN TOOL & MFG. CO.
URBANA OHIO, U. S. A.



The Economy of Employing Specialists



UNCLE SAM, in mobilizing the nation's resources, heads his various commissions with recognized specialists. A railroad official regulates transportation, an engineer supervises shipbuilding, a banker negotiates loans, etc.

Why not follow Uncle Sam's lead? Let us design and build your jigs, fixtures, dies, gages and special machinery? We're recognized specialists for such products.

We also manufacture screw machine products up to 1 $\frac{3}{4}$ " diameter. Ask us for details.

TRADE **MEHL** MARK
MADE

The Symbol of Success in Duplicate Manufacture.

Quotations Furnished on Request.

Mehl Machine Tool & Die Co.

ROSELLE
NEW JERSEY



What Krasberg O.K.'s is Right



Who is Your Toolmaker?

YOU can bet your last dollar on the accuracy and workmanship of a Krasberg-made die, tool jig, fixture, etc. The constructive energy of a complete and well rounded organization of experts is centered on a single purpose—to carry out specifications to the letter. Because we specialize in high-grade production we can do this work economically; because we have every modern facility at command we can do it quickly.

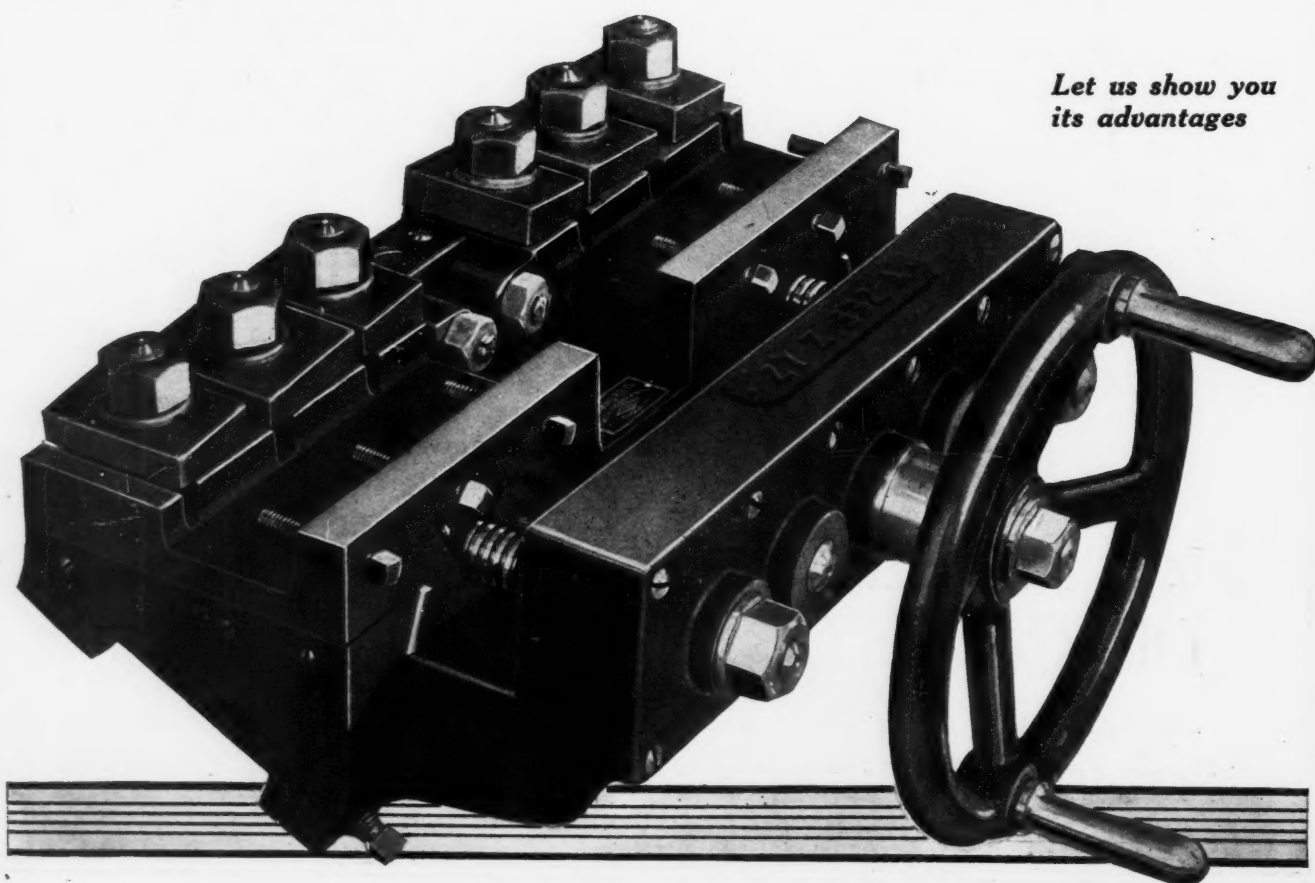
If you have blueprints or sketches of your work send them along. We will follow them absolutely and guarantee satisfaction. If your problems are not yet worked out we shall we glad to help solve them.

Krasberg Service extends from just plain tools to special machines—a dependable time-, trouble-, money-saving service.

KRASBERG MANUFACTURING CO.

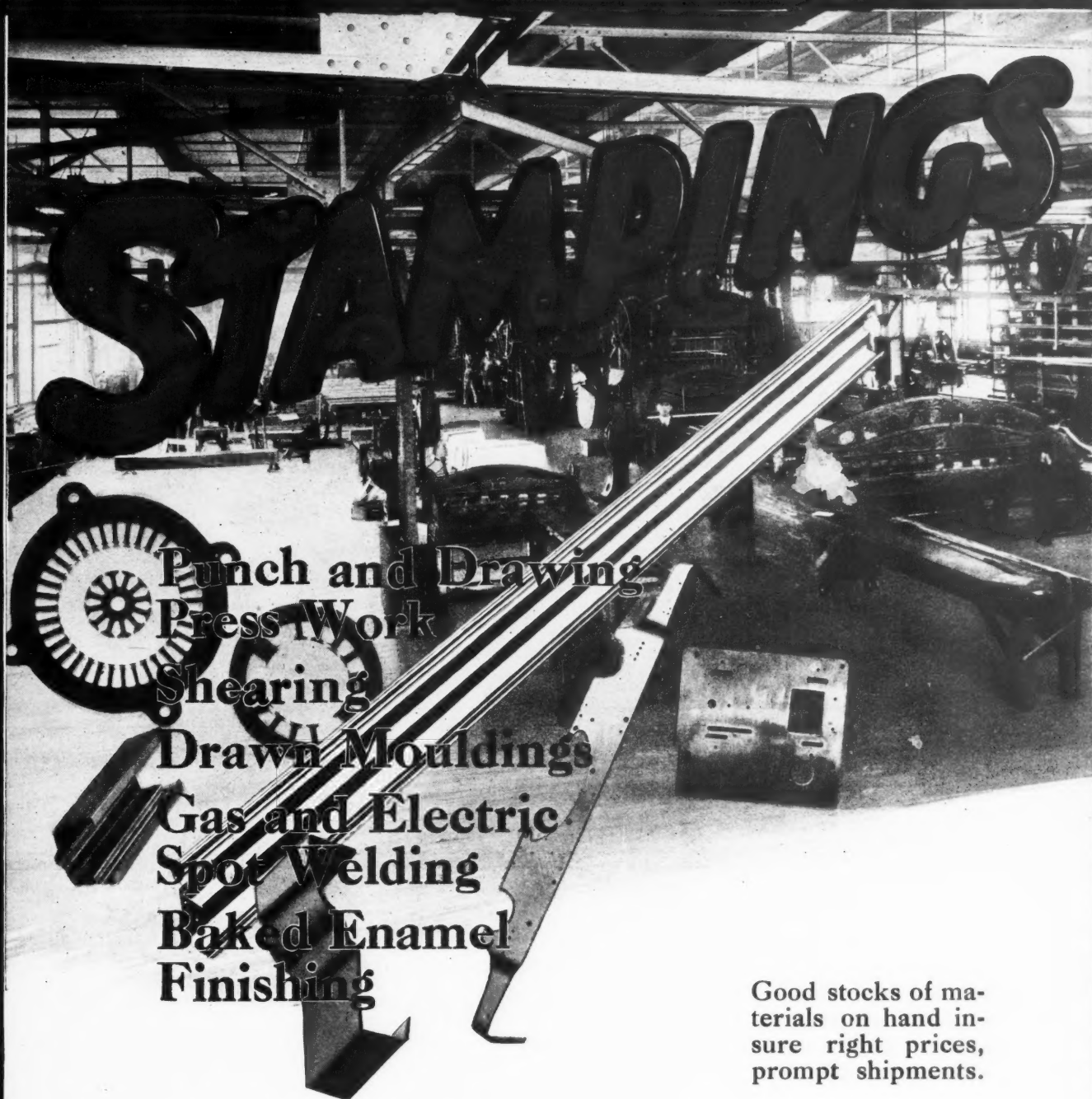
412-420 Orleans Street

CHICAGO, ILLINOIS



*Let us show you
its advantages*

CONTRACT WORK



Punch and Drawing
Press Work
Shearing
Drawn Mouldings
Gas and Electric
Spot Welding
Baked Enamel
Finishing

Good stocks of materials on hand insure right prices, prompt shipments.

An excellent plant—well equipped for quantity production of parts or finished articles—in sheet steel or other metals—both heavy and light gauges.

Please mention MACHINERY.

SOLAR METAL PRODUCTS CO., Inc.
COLUMBUS OHIO, U. S. A.



332

CONTRACTWORK



THE COLUMBUS DIE TOOL & MACHINE COMPANY

COLUMBUS

OHIO, U.S.A.

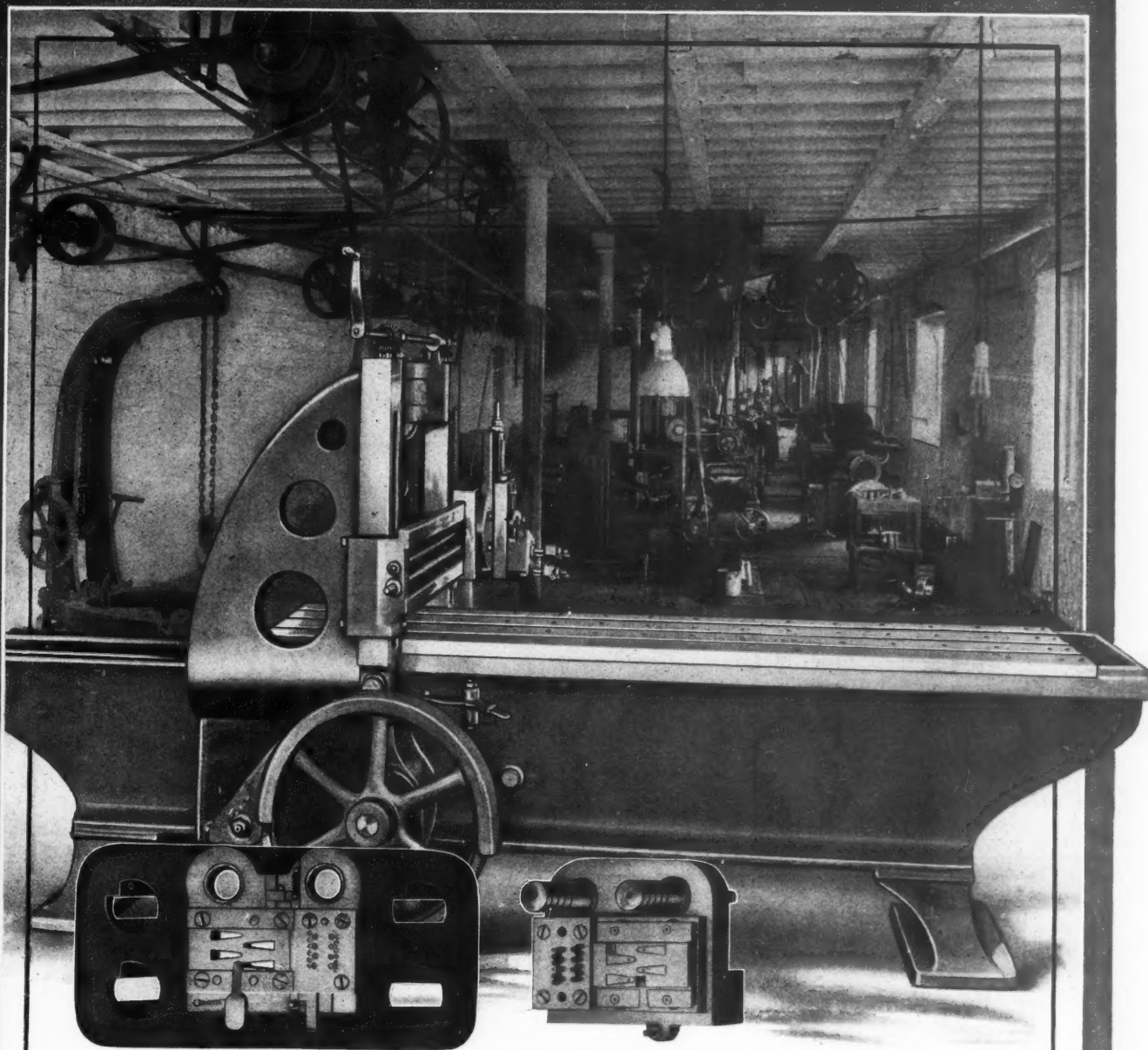
Designers and Manufacturers of
Special Tools, Dies, Jigs, Fixtures,
Cutters, Reamers, Gauges,
Machines

Founded 1906

Example
Drill jig.
53 Drill Guide
Bushings, greatest
error in center
distance 0.0015".

✓QUALITY
✓SCOPE
SERVICE
EQUIPMENT
CAPACITY
EXPERIENCE





MORE EQUIPMENT

—The Logical Answer To Greater Demand

We've added more machines, more equipment and increased our facilities—had to do it—to meet the demands for Urbana-made tools, dies, jigs, fixtures, etc. We are now better prepared than ever before, to meet your most exacting requirements.

Speaking of exacting requirements, the Follow Die shown is a good example of Urbana skill. Punches 20 holes and blanks four pieces every stroke. Holes are five per piece, 0.075" and 0.052" and 0.144" diameter. Every dimension, size, spacing, punching and blanking is within 0.001" limit. *If you want a goob job on that next die, let us make it for you.*

URBANA TOOL & DIE CO., Urbana, Ohio

Chicago Representative: Dale-Brewster Machinery Co., 547 Washington Boulevard, Chicago, Ill.

MODERN

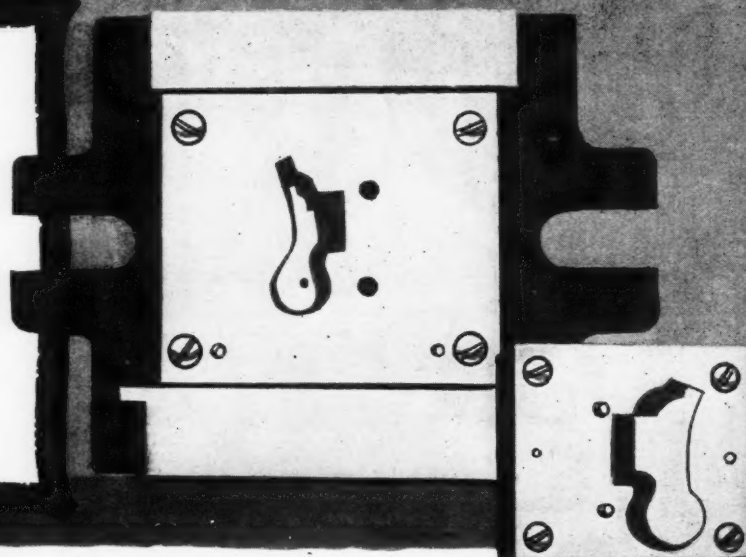
TOOL DIE AND MACHINE CO

COLUMBUS OHIO

Who makes your dies is by no means as important as how well he does his work—and how promptly.

We guarantee satisfaction in all we do. We refuse to contract for more work than we can handle promptly. Our customers will tell you we are thoroughly capable.

We'll be glad to hear from you.



STAMPINGS

Dies, Jigs, Tools, Pressed Metal Parts turned out by us have quality, accuracy, suitable price and positively prompt delivery to recommend them. We furnish estimates from blue prints or samples and solicit trial orders.

Lansing Stamping & Tool Co.
LANSING Dept. D MICHIGAN



DO YOU GET IT?

A monthly nugget of food, sunshine and entertainment. The man who edits it writes it as a pleasure—not as a duty. Sent free to anyone anywhere without obligation.

Send us your name and address on business letterhead, and mention MACHINERY

THE GLOBE MACHINE & STAMPING CO.
CLEVELAND, OHIO

Tool Making

The MOORE-EASTWOOD MANUFACTURING CO.
DAYTON OHIO

THE accuracy of our work, together with our prices and deliveries, should greatly influence you in your selection of firms to manufacture your JIGS, FIXTURES, TOOLS, DIES, GAUGES and SPECIAL MACHINERY. We also manufacture surface plates.

We Are Expert Tool Makers on Fixtures, Gauges, Jigs, Tools and Dies

**COMPLETE OUTFITS
OUR SPECIALTY**

We make all kinds—What do you need?

WM. GARDAM & SON, Inc.
108-114 Park Place - - New York
Established 1870—Incorporated 1901



Our Gridley Department

is at

Your Service

We are equipped and fully prepared to supply screw machine products, up to 1 3/4" diameter, on short notice.

Our new Gridley Automatic installation is now ready. Let us have some of your contract work.

The Inter-state Machine Products Co., Inc.
ROCHESTER NEW YORK



**LET OUR
 SERVICE DEPT.
 SOLVE
 YOUR
 SPRING
 PROBLEMS**

The Making of SPECIAL SPRINGS

is our business, and we are glad to send our Booklet No. 7-I to help you in designing them, or glad to have you put it up to our Service Department.

Write us.

THE WALLACE BARNES CO.

South and Parallel Streets
 Bristol, Conn., U. S. A.

JIGS, DIES AND TOOLS

Stampings and Electro Plating

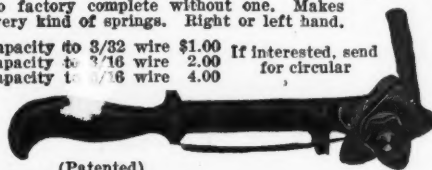
Contract work solicited

ROCKFORD METAL SPECIALTY CO.
ROCKFORD ILLINOIS

Hjorth Perfection Spring Winder

No factory complete without one. Makes every kind of springs. Right or left hand.

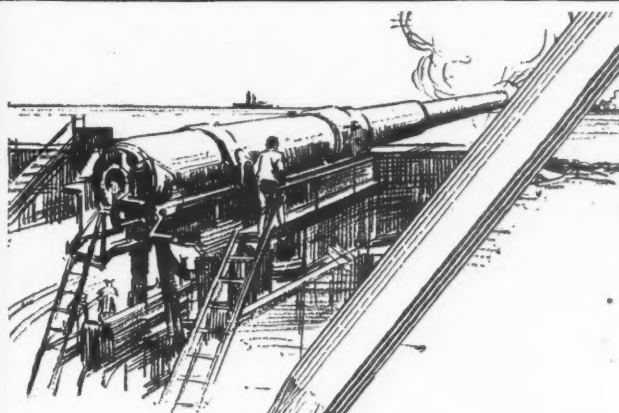
Capacity to 3/32 wire \$1.00 If interested, send
 Capacity to 3/16 wire 2.00 for circular
 Capacity to 1/8 wire 4.00



(Patented)

**Hjorth
 Lathe & Tool
 Company**

27 School St.,
 Boston, Mass.
 Works:
 Woburn, Mass.



A Pencil Directs Our Coast Defense

Intricate fortification plans and big-gun charts must be drawn with a dependable pencil. The importance of a strong, smooth, long-wearing lead to an engineer can hardly be overestimated.

DIXON'S ELDORADO

"the master drawing pencil"

has proved itself "*the master drawing pencil*" in every case where it has been used. No work is too hard, no lines too fine, no shading too difficult. If it can be done by pencil, there is one or more of the 17 degrees of the Eldorado that can do it best.

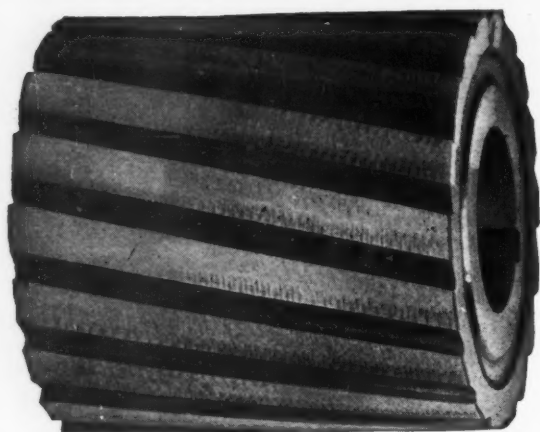
Write us on your letter head for full-length samples of your favorite degrees.

JOSEPH DIXON CRUCIBLE COMPANY
 Dept. 74-J, Jersey City, N. J.

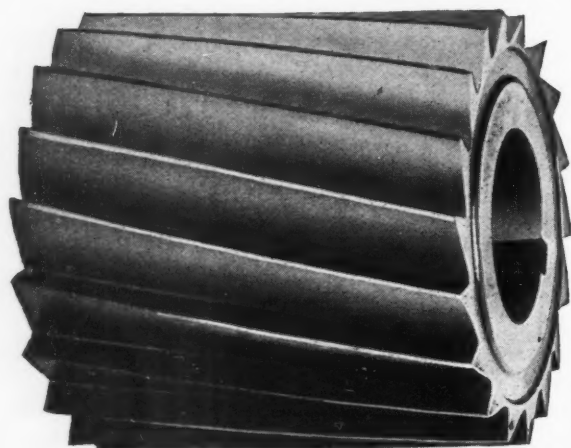
DIXON'S BEST WHITE N°352

writes white on blueprints





Send the cutter along today.

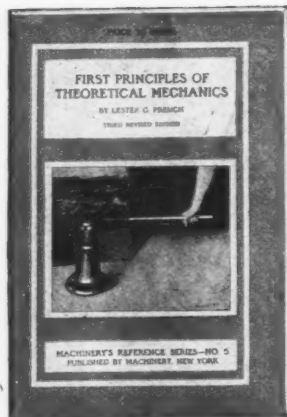


HERE'S the "BEFORE AND AFTER" appearance of a milling cutter that went, *via* Sutherland treatment, from the scrap-pile back to active service; from a piece of junk into a new cutter. And the important point is that it regained its efficiency *without annealing*. We guarantee to preserve the original temper absolutely.

A New Cutter for an Old One Without Annealing

If you are a user of high-speed milling cutters and would welcome the opportunity to save 60 per cent on your bills, here's your chance. Let us recut one of your worn cutters and offer you first-hand evidence of just what you can expect.

SUTHERLAND TOOL CO.
723 Ann Arbor Street FLINT, MICHIGAN



First Principles of Theoretical Mechanics Reference Book No. 5

This book gives briefly and clearly the fundamental principles upon which the science of mechanics is founded, and presents them in a way which makes them understood by the reader even if he has very little mathematical knowledge. The book is adapted for the designer and draftsman, as well as for the machinist or toolmaker who wants to increase his knowledge of the theoretical principles upon which machine design is based.

25 Cents a Copy.

Published by

The Industrial Press
140-148 Lafayette St. New York

WANTED CORRESPONDENCE WITH HIGH-GRADE MEN

The undersigned conducts confidential negotiations for high-grade positions, and invites correspondence from men qualified for executive, administrative, technical, engineering, manufacturing or professional positions carrying salaries not less than \$2,500 and up to \$25,000. I provide a confidential high-grade service to locate openings through correspondence, and to conduct confidential preliminary negotiations without jeopardizing present connections. This is effected through an active, constructive, individual campaign for each client; in strict confidence. Established 1910. Not an employment agency. Send name and address only for explanatory details.

R. W. BIXBY
7 Niagara Square Buffalo, N. Y.



KASENIT

Non-Poisonous

Open-Fire
Hardening Compound

Rapid and uniform surface hardening without poisonous smoke and fumes. Replaces dangerous materials heretofore used. Ask your dealer or write us.

"KASENIT No. 4"

Is the Perfect Carbonizer for oven work. Absolutely uniform and dependable results at low cost.

KASENIT COMPANY
11 Water Street New York

This box tells of the up-to-date Methods of Case-Hardening. Copy sent free on request.

TOOL DESIGNERS WANTED

Experienced men for designing all classes of jigs, fixtures and gauges. State in first letter **FULL ACCOUNT** of your *past experience*, names of companies with whom you have worked, how long with each and on what class of work. State rate of wages expected.

OHMER FARE REGISTER COMPANY, BOX 976 Dayton, Ohio

PATENTS

C. L. PARKER
Ex-member Examining Corps,
U. S. Patent Office

Attorney-at-Law and Solicitor of Patents

American and foreign Patents secured. Searches made to determine patentability, validity and infringement.

Handbook for inventors sent upon request.

McGill Building WASHINGTON, D. C.

CLASSIFIED ADVERTISEMENTS

SITUATIONS, HELP WANTED, FOR SALE, ETC.

Advertisements in this column, 20 cents a line, seven words to a line. The money should be sent with the order. Answers addressed to our care will be forwarded. Original letters of recommendation should not be enclosed to unknown correspondents

HELP WANTED

SHOP AGENT.—Live man to distribute our tools. Good chance. WELLES CALIPER CO., Milwaukee, Wis.

WANTED.—DIE SINKERS (Drop Forgings); steady work; high rates; 9 hours per day. J. H. WILLIAMS & COMPANY, Brooklyn, N. Y.

WANTED.—MACHINE SHOP FOREMAN for shop which does all repair work for rolling mill. Applicant must have similar experience. This is a good steady job for the right man. Box A135, care MACHINERY, 148 Lafayette St., New York.

SALESMAN WANTED.—We want a man to arrange for tests and make sales of Belt-ol, the scientific oil for belts. Salary and commission. E. R. SENN & CO., 52 Vanderbilt Ave., New York City.

SCRAPERS AND FIRST-CLASS ASSEMBLERS wanted at once by builder of high-grade tool-room lathes. Must be steady and furnish references. Good wages and permanent work. Box A72, care MACHINERY, 148 Lafayette St., New York.

WE INVITE APPLICATIONS from first-class Cleveland Automatic Operators and Job Setters accustomed to operating 3 $\frac{1}{2}$ " and 5 $\frac{1}{2}$ " machines. Steady employment to capable men. Box A125, care MACHINERY, 148 Lafayette St., New York.

WANTED.—MECHANICAL DRAFTSMAN for permanent position. Location near New York City. Must have at least five years' experience in the detail of machine parts. State age, experience, salary expected, and give references. Box A140, care MACHINERY, 148 Lafayette St., New York.

OPERATOR to take charge of seven gear cutting and five milling machines. Must be able to take complete charge of department. Salary \$40.00 to start. Give complete details as to experience, age, etc., to Box A139, care MACHINERY, 148 Lafayette St., New York.

WANTED.—DESIGNER OF AUTOMATIC MACHINERY who has had at least ten years' experience. State former employers and full particulars. Box A130, care MACHINERY, 148 Lafayette St., New York.

WANTED.—Experienced and competent man to erect and manage shop manufacturing bridge reamers, pneumatic rivet sets, punches and general shop tools. State experience and salary. Box A127, care MACHINERY, 148 Lafayette St., New York.

WANTED AGENTS.—Saunders' Pocket "Hand Book of Practical Mechanics" for tool chest \$1.00 only. Why pay more? It fills bill for shop kinks, ready reference, simple arithmetic. Send for circular. E. H. SAUNDERS, 216 Purchase St., Boston, Mass.

WANTED.—FIRST-CLASS MECHANICAL DRAFTSMEN AND DETAILERS, having experience on rolling mill and heavy machinery. State age, nature of experience, salary and when services will be available, in your first letter. Box A107, care MACHINERY, 148 Lafayette St., New York.

WANTED.—In the Sales Department of a prominent manufacturer of pneumatic machinery, men of at least thirty-four years of age with college education or its equivalent, who have had mechanical training and shop experience. Good opportunity for the right men. Give references, state experience and salary expected. Box A133, care MACHINERY, 148 Lafayette St., New York.

MECHANICAL ENGINEER WANTED.—Salary \$160 to \$250 a month. Open to citizens of the United States over twenty-five years old. Open to non-residents of Illinois. This position occurs in the office of the Illinois Public Utilities Commission at Springfield. An unassisted examination, covering training and experience only, will be held about August 25, 1917. Those who qualify will be called to Illinois later for a personal interview. For further details and application blank, address STATE CIVIL SERVICE COMMISSION, Springfield, Ill.

WANTED.—ELECTRICIAN AND DESIGNER; one familiar with the line of portable electric tools, such as drills, grinders, and other small kindred portable electric tools. To be fully conversant with application of universal current as well as alternating and direct. Have necessary experience and machine shop practice to improve present tools and design such additional tools as may be desired. Applications treated confidentially and should give full information with salary expected. Box A134, care MACHINERY, 148 Lafayette St., New York.

HELP WANTED

DESIGNING DRAFTSMEN wanted for permanent positions with opportunity for advancement, by a large manufacturing concern near Boston, Mass. Men with steam engine, turbine or pump experience preferred. Address, stating former experience, education, age, salary expected, etc., Box A132, care MACHINERY, 148 Lafayette St., New York.

MACHINISTS.—Capable men accustomed to machine tool work can secure steady employment on second shift with good wages. We need men on lathes, turret lathes, planers, horizontal boring machines; also vise hands and machine erectors. Transportation refunded after two weeks of satisfactory service. Write for application blank. Plainfield has a population of 35,000, is located 25 miles from New York, on the C. R. R. of N. J., and is a good home city in which to settle down. NILES-BEMENT-POND CO., Pond Works, Plainfield, N. J.

WANTED.—Chief Draftsman and Designing Engineer, over six to eight men, on Addressograph improvements and auxiliary machinery. Give full particulars in application, which will be kept strictly confidential if so desired. This is an exceptional opportunity for a good man with ability and experience on light machine work. ADDRESSOGRAPH COMPANY, 901 W. Van Buren St., Chicago, Ill.

GENERAL FACTORY EXECUTIVE.—High-grade Mechanical Engineer wanted for position of Works Superintendent, having direct charge of all power and maintenance work in a factory of over two thousand employees. Applicant must be able to show that he has made good previously in a similar position and must have pronounced executive and machine design ability. A desire to work harmoniously with organization a prime qualification. In first letter state age, salary and complete record of experience. Location, New York district. Permanent position for a real man. Box A129, care MACHINERY, 148 Lafayette St., New York.

SITUATIONS WANTED

DETROIT REPRESENTATIVE wants a good line to sell automobile manufacturers. Acquainted with trade for several years. E. E. ROUECH, 775 Grand River Ave., Detroit, Mich.

EXPERIENCED MECHANICAL ENGINEER with commercial experience, having New York office and foreign connections, desires to represent manufacturers of machinery and mechanical devices in the East. Address E. A. BARTH, Hudson Terminal Bldg., New York.

CHIEF ENGINEER, at present located with half million dollar corporation, manufacturing locomotive cranes, desires connection with live organization manufacturing hoisting machinery. Twelve years' experience in the design and manufacture of steam shovels, locomotive cranes, drag-lines, hoisting machinery, etc. Applicant is qualified to fill a position of responsibility and desires to connect with an organization that is alive to the opportunities presented at this time to increase business. Salary not prime object, but co-operation and congenial working conditions essential. Box A131, care MACHINERY, 148 Lafayette St., New York.

EMPLOYMENT AGENCIES

CORRESPONDENCE SERVICE

Are you qualified for position between \$2,500 and \$25,000? The undersigned, acting as confidential intermediary, will negotiate overtures through correspondence for positions of grades indicated—executive, technical, mechanical, administrative and professional—without jeopardizing present connections. Not an employment agency; no commission involved, but a reasonable fee for actual service. Established 1910; endorsements of highest character; strictest ethics employed. Negotiations cover country, all lines. The difficult and unusual case is particularly invited. Send name and address only for explanatory details. R. W. BIXBY, C1 Niagara Square, Buffalo, N. Y.

FOR SALE

GET A "LAST WORD."—The Test Indicator Par Excellence. Ask your dealer. H. A. LOWE, 1374 E. 88th St., Cleveland, O.

HYDRAULIC PRESS EQUIPMENT FOR SALE. First class in every respect. For further particulars of units, prices, etc., address Box A102, care MACHINERY, 148 Lafayette St., New York.

FOR SALE.—NEW HAWLEY DOWN DRAFT FURNACE. Size B42. Never run. Box A141, care MACHINERY, 148 Lafayette St., New York.

FOR SALE.—SIX 6" SHELL LATHES, European Tool Post Standard Equipment. Write for further particulars. Box A142, care MACHINERY, 148 Lafayette St., New York.

FOR SALE, CHEAP.—Patent No. 1127751. The only self-filling grease gun made for automobiles. A sure money-maker to right party. Don't miss this chance. WOOD FREEMAN, Owner, 5915 Thompson Ave., Tacoma, Wash.

ATTENTION! MACHINISTS.—\$1.00 buys Saunders' Pocket "Hand Book of Practical Mechanics." Increase your salary. It gets there. Send for circular. E. H. SAUNDERS, 216 Purchase St., Boston, Mass.

FOR SALE.—18 Calculagraph Clocks as used in Time and Cost Departments for recording elapsed time on work performed. All in good working order. JOHN S. MURRAY, Aluminum Company of America, Pittsburgh, Pa.

FOR SALE.—ONE EACH NO. 5 AND NO. 7 PANGBORN SAND BLAST EQUIPMENT, complete with cabinets, guaranteed in A No. 1 condition, ready for use. Full particulars upon request. Box A128, care MACHINERY, 148 Lafayette St., New York.

NEW STYLE EISLER LATHE AND DRILL PRESS TURRET HEAD. Made in five sizes. "It's an attachment." It converts any lathe into a semi-turret lathe; any ordinary drill press into a gang drill. Saves time and money, increases your production at a small cost. Get Circular B. CHAS. EISLER, 48 Dodd St., Bloomfield, N. J.

FOR SALE.—A complete and up-to-date set of Presses and Dies for making sheet metal corn poppers from start to finish. Machines have been used only a short time and in perfect order. We also offer 2,600 lbs. of cold rolled blue sheets, size 16 $\frac{1}{2}$ x 28 $\frac{1}{2}$, 30 gauge. Box A136, care MACHINERY, 148 Lafayette St., New York.

FOR SALE.—MACHINE SHOP. Fully equipped, well-established and going machine shop, situated on a side track in a large Ohio city. Has capacity for \$50,000 to \$75,000 annual business. Has 25 belted machines, consisting of horizontal boring mill, 5 lathes, 3 milling machines, 3 shapers, bench lathes and profilers, vertical millers, universal grinders, drill presses, etc. Has a thoroughly competent superintendent. Reasons for selling, failing health. Box A137, care MACHINERY, 148 Lafayette St., New York.

CONTRACT WORK

HARDENING, CARBONIZING, GALVANIZING.—C. U. SCOTT, Head of Wall St., Davenport, Iowa.

DRAFTING AND DESIGNING.—Electrical and mechanical. Competent engineer. H. E. WEIGHTMAN, 5251 Cullom Ave., Chicago.

PATENTS

PATENTS SECURED.—C. L. PARKER, Ex-member Examining Corps, U. S. Patent Office. Instructions upon request. McGill Building, Washington, D. C.

PATENTS.—H. W. T. JENNER, patent attorney and mechanical expert, 606 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had, and the exact cost. Send for full information.

MISCELLANEOUS

WANTED.—Roots or Connersville Blowers. State size, condition and price. Address P. O. Box 206, Newark, N. J.

HOUPERT MACHINE COMPANY is in the market for a double spindle machine for cutting lap joint piston rings, both sides at the same time. HOUPERT MACHINE CO., 351 West 52nd St., New York.

FOREIGN MACHINERY MERCHANTS

AUSTRALIA

R. L. SCRUTTON & CO., Ltd.,
161 Clarence Street, Sydney, N. S. W.
IMPORTERS OF MACHINE TOOLS, HAND TOOLS,
WOODWORKING MACHINERY AND ALL
ENGINEERING SPECIALTIES, AND
STEAM USERS' REQUISITES.
London Office: Lloyds Avenue House, London, W.

BELGIUM

FENWICK FRERES & CO.,
1, Avenue Blonden, Liege.
AMERICAN MACHINERY AND TOOLS

E. ISBEOQUE & CO.,
Offices, Salesrooms and Demonstration Halls:
1, Square de l'Aviation, Brussels.
33, Rue des Poignes, Antwerp.
AMERICAN MACHINE TOOLS, SMALL TOOLS
AND MACHINERY.
New York Offices: 15 Park Row.
Telephone: Cortlandt 5353.

LANDRE & GLINDERMAN, Brussels.
131 Boulevard Lambertmont.
Importers of Machinery and Machine Tools.

R. S. STOKVIS & FILS, Soc. An.
No. 1 Boulevard du Jardin Botanique, Brussels.
MECHANICAL ENGINEERS.
MACHINE TOOLS AND TOOLS.
Rotterdam, Brussels, Paris, Petrograd. (Soerabaja,
Batavia, Semarang, Dutch East Indies).
New York Office: 17 Battery Place, New York City.

DENMARK

V. LÖWENER
Vesterbrogade 9 B, Copenhagen
MACHINERY AND TOOLS

NIELSEN & WINTHER, Ltd., Copenhagen.
MACHINE TOOLS AND SMALL TOOLS

WILH. SONESSON & CO., Ltd.,
Copenhagen City and Freeport.

ENGLAND

BURTON, GRIFFITHS & CO., Ltd.,
Ludgate Square, Ludgate Hill, London, E. C.
110 West 40th St., New York City.
IMPORTERS OF AMERICAN MACHINE TOOLS.
Also at Manchester and Glasgow.
A B C and Lieber's Codes used. Telegrams,
"Hibou," London.

CHAS. CHURCHILL & CO., Ltd.,
9 to 15, Leonard St., London, E. C.
THE PIONEERS OF AMERICAN TOOL TRADE
IN GREAT BRITAIN.

Established 1865. Large Warehouses in Birmingham,
Manchester, Newcastle-on-Tyne, Glasgow. See ad-
vertisements in this journal for agencies.

COATS MACHINE TOOL CO., Ltd.,
Caxton House, Westminster, London, S. W.
TOOL MAKERS AND IMPORTERS OF AMERICAN
MACHINERY.
Branches: Glasgow and Newcastle-on-Tyne.
New York Office: 30 Church St.

GEO. W. GOODCHILD & MACNAB,
56-57-58 Eagle St., Southampton Row, London, W. C.
IMPORTERS AND EXPORTERS OF AMERICAN MA-
CHINERY, TOOLS AND ENGINEERING SPECIALTIES.
Cables: "Whizzing." Codes: Lieber's, A B C 5th edition,
Western Union and Private.

GEORGE HATCH, Ltd.,
20-21, Queenhithe, Upper Thames St., London, E. C.
IMPORTERS OF MACHINE AND HAND TOOLS, EN-
GINEERING SUPPLIES. SPECIALTY: NEW TOOLS.
Cable, George Hatch, London. Codes, A B C and
Lieber's.

ALFRED HERBERT, Ltd., Coventry.
IMPORTERS OF AMERICAN LABOR SAVING
TOOLS OF ALL DESCRIPTIONS.
Showrooms: London, Manchester, Glasgow and
Coventry. Cable: "Lathe, Coventry." Codes: Lieb-
er's, A B C 5th edition, and private.

RICHARD LLOYD & CO.,
Steelhouse Lane, Birmingham.
IMPORTERS OF AMERICAN MACHINERY, TOOLS
AND ENGINEERING SPECIALTIES
Established 1856. Cable Address: "Cogs, Birming-
ham." Lieber's and A B C Codes.

POLLOCK & MACNAB, Ltd., Bredbury, Manchester.
IMPORTERS OF AMERICAN MACHINE TOOLS.
Cables: Macnab, Woodley. Codes: A B C, A I, Lieber's.

UNIVERSAL MACHINERY CORP., Ltd.,
General Offices, 326 Old Street, London, E. C.
Demonstration Shops:
48-49 Cowper Street, London, E. C.
IMPORTERS OF AMERICAN MACHINE TOOLS.
Branches: Paris, Lyons, Milano, Genova; Petrograd,
Moscow, Ekaterinberg, Russia.

FINLAND

**FINSKA A/B. G. HARTMANNS MASKIN-
AFFÄR,** Helsingfors.
MACHINERY AND TOOLS

FRANCE

**ALLIED MACHINERY COMPANY
OF AMERICA,**
19 Rue de Rocroy, Paris.
HIGH GRADE AMERICAN MACHINE TOOLS.
Branches: Brussels, Turin, Genoa, Zurich, Budapest.
Cable Address: "Almacoa."
New York Office: 120 Broadway.

AUX FORGES DE VULCAIN,
3 Rue Saint Denis, Paris.
IMPORTERS OF MACHINE TOOLS.
VERY LARGE STOCK.

LOUIS BESSE, 39 Rue de Lappe, Paris.
IMPORTER OF AMERICAN MACHINERY AND
TOOLS—LARGEST STOCK IN PARIS.
Agent for the Whitcomb-Blaisdell Machine Tool Co.,
Wm. E. Gang Co., J. E. Snyder & Son,
Lapointe Machine Tool Co., etc.
Cable address: Besselp, Paris. Lieber's Code.

EDGAR BLOXHAM, M. I. E. E.,
Offices and Show-rooms, 12, Rue du Delta, Paris.
IMPORTER OF AND DEALER IN AMERICAN
MACHINERY, TOOLS AND SUPPLIES.
Telegrams: Bloxham-Paris. Code: Western Union.
New York Office: Grand Central Terminal Bldg.

BURTON FILS, 68 Rue de Marais, Paris.
IMPORTERS OF AMERICAN MACHINE TOOLS
AND MACHINERY SUPPLIES

LEON CHAPUIS & CIE.,
IMPORTERS OF MACHINE TOOLS
18 Rue du Plat, Lyon.
36 Boulevard Magenta, Paris.

FENWICK FRERES & CO.,
8, Rue de Rocroy, Paris.
AMERICAN MACHINERY AND TOOLS.
Branches or Representatives: Liege, Turin, Zurich,
Barcelona and Lisbon.

GLAENZER & PERREAUD,
18-20, Faubourg du Temple, Paris
IMPORTERS OF AMERICAN MACHINERY
and Mechanical Supplies. Agent for the Niles-Bement-
Pond Co., etc. Lieber's Code, A I Code, A B C Code.
Cable Address: Blakenilles, Paris. New York Office:
43-47 West 33rd Street.

ALFRED HERBERT (France), Ltd.,
47, Boulevard de Magenta, Paris
IMPORTERS OF AMERICAN LABOR SAVING
TOOLS OF ALL DESCRIPTIONS.
Cable: "Hexagon, Paris." Codes: Lieber's and
private.

R. S. STOKVIS & FILS, Soc. An.
Rue Lafayette, 103, Paris.
MECHANICAL ENGINEERS, MACHINE TOOLS
AND TOOLS.
Rotterdam, Brussels, Paris, Petrograd. (Soerabaja,
Batavia, Semarang, Dutch East Indies).
New York Office: 17 Battery Place, New York City.

HOLLAND

H. G. AIKEMA & CO., Rotterdam.
ENGINEERING AGENTS AND MERCHANTS.
Importers of American Machinery and Tools.

LANDRE & GLINDERMAN, Amsterdam.
ROYAL MACHINERY STORES.
Importers of Machinery and Machine Tools.

PECK & COMPANY, Amsterdam
IMPORTERS OF AMERICAN MACHINERY.
Tools, Factory Supplies. Lieber's and A B C Codes.

POST VAN DER BURG & CO., Rotterdam
DEALERS IN AMERICAN MACHINERY
AND TOOLS

SPLIETHOFF, BEEUWKES & CO., Rotterdam.
ENGINEERING AGENTS AND MERCHANTS.

FRED. STIELTJES & CO., Amsterdam
ENGINEERS AND IMPORTERS OF AMERICAN
MACHINERY.

R. S. STOKVIS & ZONEN, Ltd. Rotterdam
MECHANICAL ENGINEERS, TECHNICAL
DEPARTMENT II.
MACHINE TOOLS AND TOOLS.
Rotterdam, Brussels, Paris, Petrograd. (Soerabaja,
Batavia, Semarang, Dutch East Indies).
New York Office: 17 Battery Place, New York City.

VAN RIETSCHOTEN & HOUWENS,
West Zeedyk, 554, Rotterdam.
LARGEST DEALERS IN AMERICAN MACHINERY
in Holland. New show-room, 11,000 sq. feet. Cable:
"Machinery." Codes used: A B C, 5th edition; Lieber's.

WYNMALEN & HAUSMANN, Rotterdam
IMPORTERS OF FIRST-CLASS AMERICAN
MACHINERY

ITALY

FENWICK FRERES & CO.,
6 Via Lagrange, Turin.
AMERICAN MACHINERY AND TOOLS.

GRIMALDI & C., Casella 320, Genova
AMERICAN MACHINERY AGENTS.
Branch House in Milan, Italy.

ALFRED HERBERT, Ltd., Milan.
19 Via Pontaccio.
IMPORTERS OF AMERICAN LABOR SAVING
TOOLS OF ALL DESCRIPTIONS.
Cable: "Herbert, Milan." Codes: Lieber's and pri-
vate.

ITALY—(Continued)

ING. ERCOLE VAGHI,
MACHINE TOOLS. Corso Porta Nuova 34, Milan.

W. VOGEL, Foro Bonaparte 44A, Milan.
AGENT FOR AMERICAN MACHINERY.

JAPAN

ALFRED HERBERT, Ltd.,
14, Yamashita-Cho, Yokohama.
IMPORTERS OF AMERICAN LABOR SAVING
TOOLS OF ALL DESCRIPTIONS.
Cable: "Lathe, Yokohama." Codes: Lieber's, A B C
5th edition, and private.

NORWAY

J. S. COCK, Christiania.
IMPORTER OF ENGINEERING SPECIALTIES FOR
STEAMERS AND MANUFACTURING INDUSTRIES,
MACHINE TOOLS, ENGINEERS SUPPLIES, OILS
AND CUP GREASES, ETC.

A/S. G. HARTMANN, Dronningens gt 13, Christiania
MACHINERY AND TOOLS
Christiania, Bergen, Norway; Stockholm, Sweden;
Helsingfors, Finland.

V. LÖWENERS MASKINFORRETNING,
Kirkegaden 20, Christiania.
MACHINERY AND TOOLS.
Sverre Moha.

K. LUND & CO., Dronningens gt. 4, Christiania
MACHINERY AND TOOLS

RUSSIA

HEINTZ & TASCHKEIT, Inc.
W. O. 10th. Line No. 1, Petrograd.
ENGINEERS AND IMPORTERS.
Telegrams: "GIV-PETROGRAD."

IZNOSSKOFF & CO.
MACHINE TOOLS AND SMALL TOOLS
Petrograd, Moscow, Ekaterinburg, Odessa.
Cable Address: Iznooskoff, Petrograd.
New York Office: Singer Building, 149 Broadway.

V. LÖWENER
Mjasenitzkaja 32, Moskau
MACHINERY AND TOOLS

M. METT & CO., 6 Simeonovskaja, Petrograd.
ENGINEERS AND TECHNICAL BUREAU.
MACHINE TOOLS AND SMALL TOOLS.

C. SCHINZ, Mechanical Engineer,
Gorochowaja 4, Petrograd.
MACHINE TOOLS AND SMALL TOOLS
Cable Address: Konus-Petrograd.

GR. WEINBERG & AL. POSNER
ENGINEERING CO.
Foorstadskaja 31, Petrograd. Cables: "Greweco."
GENERAL MACHINERY IMPORTERS,
MANUFACTURERS' REPRESENTATIVES.
Branches and Agencies throughout Russia.
New York Office: Equitable Bldg., 120 Broadway.

SOUTH AFRICA

D. DRURY & CO., Central House, Johannesburg
MACHINERY AND SMALL TOOLS, GENERAL
ENGINEERING SUPPLIES, INCLUDING MIN-
ING MATERIALS. Cables: "Drurco."
Representing the whole of South Africa for the
above lines.

SPAIN

CASAMITJANA HERMANOS,
Cortes 660, Barcelona.
MACHINERY, STEEL, TOOLS, ETC.

LA MAQUINARIA ANGLO-AMERICANA
R. d'Aulignac. Cortes 559, Barcelona.
MACHINERY, TOOLS AND SUPPLIES.

SWEDEN

A/B. G. HARTMANNS MASKINAFFÄR,
Vasagatan 5, Stockholm.
MACHINERY AND TOOLS

B. A. HJORTH & COMPANY,
Klara Norra Kyrkogata 31, Stockholm
MACHINERY AND TOOLS

SAM LAGERLOF'S MACHINE-BUREAU,
Stockholm.
SPECIALTY: MACHINE TOOLS.
Cable: "Machinlagerlot." A B C and Lieber's Code.

AKTIEBOLAGET V. LÖWENER,
Vasagatan 14, Stockholm.
MACHINERY AND TOOLS.
Cable: Stallowener. Codes: Lieber's and A B C.

WILH. SONESSON & CO., Ltd.,
Malmo, Gothenburg and Stockholm.

SWITZERLAND

**THE AMERICAN MACHINERY IMPORT
OFFICE,** 24, Weinbergstrasse, Zurich.

J. LAMBERCIER & CIE, Geneva.
IMPORTERS OF AMERICAN MACHINERY
Technical Appliances

HENDEY LATHES



**"No Equal—
Or We Would
Have It."**

That is what F. F. Stein of Wm. P. Stein & Co., Rochester, N. Y., has to say of the Hendey Lathe. There are seven "Hendeys" in the Stein shops, the oldest 10 years on the job, the youngest only just recently installed. The machines handle general tool and die work in a

way that makes the Stein toolmakers happy. One of the jobs (shown above) is turning a sector of an armature die, a bit of machining that calls for a real lathe. Hendey Lathes are the real thing—accurate to the last degree, speedy, easy to operate and indefatigable workers. Ideal for tool room or other fine work. We shall be glad to cover Hendey advantageous features in detail. *Write us.*

THE HENDEY MACHINE COMPANY

TORRINGTON, CONNECTICUT, U. S. A.

901 Singer Building, New York

Cleveland.....W. M. Pattison Supply Co.
Detroit.....W. M. Pattison Supply Co.
Pittsburgh.....
Laughlin-Barney Mch. Co., Union Bank Bldg.
Syracuse.....Syracuse Supply Co.
Buffalo, Syracuse Supply Co., Ellicott Sq. Bldg.

141 Milk Street, Boston

Philadelphia.....
St. Louis.....Sherritt & Stoer Co., 603 Finance Bldg.
San Francisco.....Colcord-Wright Mch. and Supply Co.
Rochester.....Pacific Tool and Supply Co.
Syracuse Supply Co.

618 Washington Boulevard, Chicago

Montreal.....Williams & Wilson
Toronto, Winnipeg, Vancouver and
St. Johns, N. B.....A. R. Williams Mch. Co.
Great Britain.....Chas. Churchill & Co., London
Russia.....Iznoskoff & Co., Petrograd, Moscow
South Africa.....D. Drury & Co., Johannesburg

MACHINERY'S PRODUCT INDEX

FOR LOCATION OF ADVERTISEMENTS OF MANUFACTURERS LISTED IN THIS INDEX,
SEE ALPHABETICAL INDEX, PAGES 361-362

Abrasive Cloth and Paper

Carborundum Co., Niagara Falls, N. Y.
Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.

Accumulators, Hydraulic

Bethlehem Steel Co., South Bethlehem, Pa.
Chambersburg Engineering Co., Chambersburg, Pa.
Elmes Eng. Works, Chas. F., 222 N. Morgan St., Chicago, Ill.
Hydraulic Press Mfg. Co., 84 Lincoln Ave., Mt. Gilead, O.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Treadwell Engineering Co., Easton, Pa.
Watson-Stillman Co., 192 Fulton St., New York.

Air Hoists

See Hoists, Air.

Alloys, Steel (Tungsten, Uranium, Etc.)

Haynes Steelite Co., Kokomo, Ind.
Standard Alloys Co., Pittsburgh, Pa.
Vanadium-Alloys Steel Co., Pittsburgh, Pa.

Aluminum Solder

So-Luminum Mfg. & Eng. Co., 1790 Broadway, New York.

Angle Plates, Universal

Boston Scale & Mch. Co., Boston, Mass.

Arbor Presses

See Presses, Arbor.

Arbors and Mandrels, Expanding

Manufacturers Equipment Co., 175 No. Jefferson St., Chicago, Ill.
McCrosky Reamer Co., Meadville, Pa.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Western Tool & Mfg. Co., Springfield, O.

Arbors and Mandrels, Solid

Advance Tool Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Detroit Twist Drill Co., Detroit, Mich.
Morse Twist Drill & Machine Co., New Bedford, Mass.
National Tool Co., Cleveland, O.
National Twist Drill & Tool Co., Detroit, Mich.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Inc., J. M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., 1000 West 120th St., Chicago, Ill.

Babbitt

Ajax Metal Co., Philadelphia, Pa.
Besly & Co., Chas. H., 120-B North Clinton St., Chicago, Ill.
Doehler Die-Casting Co., Court and Ninth Sts., Brooklyn, N. Y.
Light Mfg. & Foundry Co., Pottstown, Pa.
Lumen Bearing Co., Buffalo, N. Y.

Balancing Tools

Norton Grinding Co., Worcester, Mass.
Rockford Tool Co., Rockford, Ill.

Balls, Brass, Steel, Etc.

Abbott Ball Co., Elmwood, Hartford, Conn.
Atlas Ball Co., Glenwood Ave. at 4th St., Philadelphia, Pa.
Auburn Ball Bearing Co., 33 Elizabeth St., Rochester, N. Y.
Blum & Co., Julius, 510 W. 24th St., New York.
Frasse & Co., Inc., Peter A., 417 Canal St., New York.
Gwilliam Co., 253 W. 58th St., New York.
Hoover Steel Ball Co., Ann Arbor, Mich.
Metal Specialty Mfg. Co., Waterbury, Conn.
Rochester Ball Bearing Co., Rochester, N. Y.
S K F Ball Bearing Co., Hartford, Conn.

Bars, Boring

See Boring Bars.

Bearings, Ball

Auburn Ball Bearing Co., 33 Elizabeth St., Rochester, N. Y.
Ball & Roller Bearing Co., Danbury, Conn.
Bantam Ball Bearing Co., Bantam, Conn.
Bearings Co. of America, Lancaster, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Fafnir Bearing Co., New Britain, Conn.
Gurney Ball Bearing Co., Jamestown, N. Y.
Gwilliam Co., 253 W. 58th St., New York.
Hess-Bright Mfg. Co., Front St. and Erie Ave., Philadelphia, Pa.
New Departure Mfg. Co., Bristol, Conn.
Norma Co. of America, 1790 Broadway, New York.
Rochester Ball Bearing Co., Inc., Rochester, N. Y.
S K F Ball Bearing Co., Hartford, Conn.
Standard Roller Bearing Co., Philadelphia, Pa.
Transmission Ball Bearing Co., Inc., Buffalo, N. Y.
U. S. Ball Bearing Mfg. Co., Palmer St. and Kolmar Ave., Chicago, Ill.

Bearings, Bronze, Babbitt, Etc.

Besly & Co., Chas. H., 120-B N. Clinton St., Chicago, Ill.
Brown Co., A. & F., 79 Barclay St., New York.
Bunting Brass & Bronze Co., 748 Spencer St., Toledo, O.
Doehler Die-Casting Co., Court and Ninth Sts., Brooklyn, N. Y.
Light Mfg. & Foundry Co., Pottstown, Pa.
Link-Belt Company, Chicago, Ill.
Lumen Bearing Co., Buffalo, N. Y.
Standard Alloys Co., Pittsburgh, Pa.
Titanium Alloy Mfg. Co., Buffalo, N. Y.

Bearings, Linedshaft

Hyatt Roller Bearing Co., Newark, N. J.

Bearings, Oilless

Arguto Oilless Bearing Co., 145 Berkley St., Wayne Junction, Philadelphia, Pa.
Bound Brook Oil-less Bearing Co., Bound Brook, N. J.

Bearings, Ring Oiling

Cresson-Morris Co., Philadelphia, Pa.
Link-Belt Company, Chicago, Ill.
Roversford Foundry & Mch. Co., 54 N. 5th St., Philadelphia, Pa.

Bearings, Roller

Ball & Roller Bearing Co., Danbury, Conn.
Bantam Ball Bearing Co., Bantam, Conn.
Gwilliam Co., 253 W. 58th St., New York.
Hyatt Roller Bearing Co., Newark, N. J.
Roversford Foundry & Mch. Co., 54 N. 5th St., Philadelphia, Pa.
Standard Roller Bearing Co., Philadelphia, Pa.

Belt Cement

Schieren Co., Chas. A., 73 Ferry St., New York.

Belt Clamps

Hogson & Pettis Mfg. Co., New Haven, Conn.

Belt Dressing

Cling-Surface Co., 1018 Niagara St., Buffalo, N. Y.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Graton & Knight Mfg. Co., Worcester, Mass.
Schieren Co., Chas. A., 73 Ferry St., New York.

Belt Fasteners, Metal, Leather, Etc.

Bristol Co., Waterbury, Conn.
Graton & Knight Mfg. Co., Worcester, Mass.
Greene, Tweed & Co., 109 Duane St., New York.
Schieren Co., Chas. A., 73 Ferry St., New York.

Beltin, Leather

Chicago Rawhide Mfg. Co., 1301 Elston Ave., Chicago, Ill.

Graton & Knight Mfg. Co., Worcester, Mass.

Schieren Co., Chas. A., 73 Ferry St., New York.

Belts, Endless Woven

Gilmer Co., L. H., Tacony, Philadelphia, Pa.

Bending Machines, Hydraulic, Pipe, Etc.

Buffalo Forge Co., Buffalo, N. Y.
Hydraulic Press Mfg. Co., 84 Lincoln Ave., Mt. Gilead, O.
Newman Mfg. Co., Cincinnati, O.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pedrick Tool & Mch. Co., 3639 N. Lawrence St., Philadelphia, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Treadwell Engineering Co., Easton, Pa.
Underwood & Co., H. B., Philadelphia, Pa.
Watson-Stillman Co., 192 Fulton St., New York.
Williams, White & Co., Moline, Ill.

Blocks, Chain

See Hoists, Chain, Etc.

Blowers

American Gas Furnace Co., 24 John St., New York.
Buffalo Dental Mfg. Co., Buffalo, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., 149 W. La Salle St., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Blowers, Positive Pressure

Leiman Bros., 62 E. John St., New York.

Blowpipes, Gas

Buffalo Dental Mfg. Co., Buffalo, N. Y.

Blueprint Filing Cabinets

See Cabinets, Filing.

Blueprint Machines and Paper

Buckeye Engine Co., Salem, O.
Keuffel & Esser Co., Hoboken, N. J.

Boiler Tubes

National Tube Co., Pittsburgh, Pa.

Bolt and Nut Machinery

Acme Mch. Co., Cleveland, O.
Ajax Mfg. Co., Cleveland, O.
Foots-Burg Co., Cleveland, O.
Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Machine Co., Inc., Waynesboro, Pa.
National Acme Co., Cleveland, O.
National Mch. Co., Tiffin, O.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Standard Engineering Co., Ellwood City, Pa.

Bolts and Nuts

National Acme Co., Cleveland, O.
Toledo Screw Products Co., Toledo, O.

Books, Technical

Industrial Press, 148 Lafayette St., New York.

Boosters

General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Boring and Drilling Machines, Horizontal

Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Beaman & Smith Co., Providence, R. I.
Dale-Brewster Mch. Co., Inc., 545 W. Washington Blvd., Chicago, Ill.
Fosdick Mch. Tool Co., Cincinnati, O.
Gisholt Mch. Co., Madison, Wis.
Lucas Machine Tool Co., Cleveland, O.
Manning, Maxwell & Moore, Inc., 119 W. 40th St., N. Y.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pedrick Tool & Mch. Co., 3639 N. Lawrence St., Philadelphia, Pa.
Rockford Drilling Mch. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Boring and Drilling Machines, Vertical

Bullard Mch. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Foots-Burg Co., Cleveland, O.
Fosdick Mch. Tool Co., Cincinnati, O.
Gisholt Mch. Co., Madison, Wis.
Moline Tool Co., Moline, Ill.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pedrick Tool & Mch. Co., 3639 N. Lawrence St., Philadelphia, Pa.
Quint, A. E., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Boring, Drilling and Milling

Machines, Horizontal

Beaman & Smith Co., Providence, R. I.
Cleveland Machine Tool Works, Cleveland, O.
Fosdick Machine Tool Co., Cincinnati, O.
Gisholt Mch. Co., Madison, Wis.
Landis Tool Co., Waynesboro, Pa.
Lucas Machine Tool Co., Cleveland, O.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Rockford Drilling Mch. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Universal Boring Mch. Co., Hudson, Mass.

Boring and Turning Mills, Vertical

American Tool Works Co., Cincinnati, O.
Bullard Mch. Tool Co., Bridgeport, Conn.
Cincinnati Planer Co., Cincinnati, O.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mch. Co., Madison, Wis.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.

Boring Bars

Advance Tool Co., Cincinnati, O.
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
Beaman & Smith Co., Providence, R. I.
Gisholt Mch. Co., Madison, Wis.
Pedrick Tool & Mch. Co., 3639 N. Lawrence St., Philadelphia, Pa.
Ready Tool Co., Bridgeport, Conn.
Underwood & Co., H. B., Philadelphia, Pa.

Boring Heads, Offset

Marvin & Casler Co., Canastota, N. Y.
Porter-Cable Mch. Co., Syracuse, N. Y.
Waterston, J. M., Detroit, Mich.

Boring Tools

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
Kelly Reamer Co., Cleveland, O.
Maxwell-Hutchcroft Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Ready Tool Co., Bridgeport, Conn.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Western Tool & Mfg. Co., Springfield, O.

Brazing Equipment

Buffalo Dental Mfg. Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., 149 W. La Salle St., Chicago, Ill.
Ferro-Brazing Paste Co., 1423 Farragut Ave., Chicago, Ill.

Broaches

Lapointe Mch. Tool Co., Hudson, Mass.
Lapointe Co., J. N., New London, Conn.

Broach Grinding Machines

Lapointe Co., J. N., New London, Conn.

Broaching Machines

Lapointe Co., J. N., New London, Conn.
Lapointe Mch. Tool Co., Hudson, Mass.

Bronze

Bunting Brass & Bronze Co., 748 Spencer St., Toledo, O.
Light Mfg. & Foundry Co., Pottstown, Pa.
Lumen Bearing Co., Buffalo, N. Y.
Titanium Alloy Mfg. Co., Buffalo, N. Y.

Buffers

Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Builders Iron Foundry, Providence, R. I.
Forbes & Myers, 178 Union St., Worcester, Mass.
Hisey-Wolf Mch. Co., Cincinnati, O.
Neil & Smith Electric Tool Co., Cincinnati, O.
New Britain Mch. Co., New Britain, Conn.
Stow Mfg. Co., Binghamton, N. Y.

Bulldozers

Ajax Mfg. Co., Cleveland, O.
Bliss Co., E. W., 5 Adams St., Brooklyn, N. Y.
National Mch. Co., Tiffin, O.
Watson-Stillman Co., 192 Fulton St., New York.
Williams, White & Co., Moline, Ill.

Burnishing Machinery

Abbott Ball Co., Elmwood, Hartford, Conn.
Baird Mch. Co., Bridgeport, Conn.
Globe Mch. & Stamping Co., Cleveland, O.
Metal Specialty Mfg. Co., Waterbury, Conn.

Bushings, Brass, Bronze, Etc.

Bound Brook Oil-less Bearing Co., Bound Brook, N. J.
Brown Engineering Co., 135 No. 3d St., Reading, Pa.
Bunting Brass & Bronze Co., 748 Spencer St., Toledo, O.
Johnson Bronze Co., Newcastle, Pa.
Light Mfg. & Foundry Co., Pottstown, Pa.
Lumen Bearing Co., Buffalo, N. Y.
Titanium Alloy Mfg. Co., Buffalo, N. Y.
Walworth Mfg. Co., Boston, Mass.

Cabinets, Filing

Economy Drawing Table Co., Toledo, O.
Keuffel & Esser Co., Hoboken, N. J.

Cabinets, Tool

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
Gerstner & Sons, H., Dayton, O.
Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Union Tool Chest Works, 10 Railroad St., Rochester, N. Y.
Wedell & Boers, Detroit, Mich.

Caliper Gauges

Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

Calipers, Bow

Brown & Sharpe Mfg. Co., Providence, R. I.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
Starrett Co., L. S., Athol, Mass.
Union Tool Co., Orange, Mass.

Silver's Drills Single or in Gangs

These 20-inch swing drills can be furnished singly or in gangs of 2, 3 or 4 spindles. They meet any demand for speed, strength and accuracy. The prices are also "right."

Made in four distinct styles for all modern machine shop work. Plain lever feed, lever and wheel feed, power feed and automatic stop and with back gearing.

Our catalog No. 62 illustrates and describes this line—sent on request.



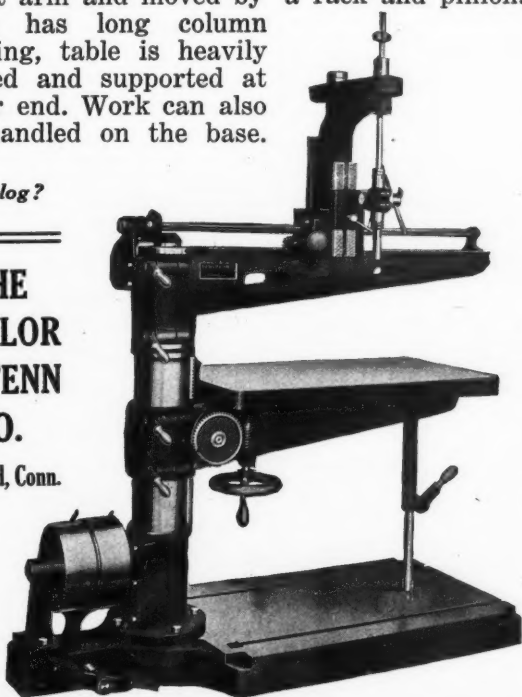
The Silver Mfg. Co.
385 Broadway, Salem, Ohio

A Wide Range Radial

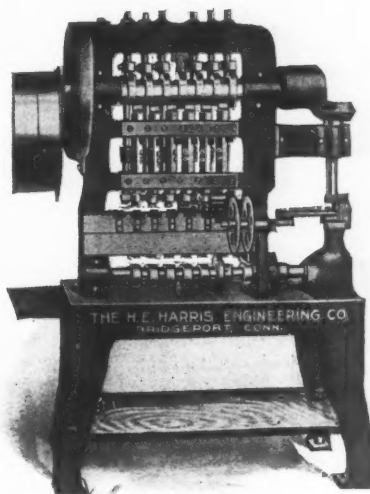
Designed to drill holes up to $\frac{3}{4}$ " in diameter, covers practically every drilling requirement within its range. The adjustments possible on head and arm enable holes to be drilled in pieces too heavy to be handled readily on other types of machines. Drilling head is mounted on a 3-foot arm and moved by a rack and pinion. Arm has long column bearing, table is heavily ribbed and supported at outer end. Work can also be handled on the base.

Catalog?

THE
TAYLOR
& FENN
CO.
Hartford, Conn.



HARRIS Automatic Multiple Plunger Press



**A Rapid Producer of Stamped,
Perforated or Embossed
Sheet Metal Parts**

If you make automobile curtain snaps, oil cups, fuse caps, percussion caps, ferrules, metal boxes, etc., and want to speed 'em up, here is your machine.

The Harris Automatic Multiple Plunger Press is rapid—runs off 35,000 to 80,000 parts per 10-hour day, allowing for all legitimate delays. Output depends, of course, on thickness of material and other purely physical features of the work in hand.

The machine produces complete parts automatically from sheet stock without manual handling. It is heavy and of latest improved design. It is well built and its high accuracy permits perfect interchangeability of tools from one machine to another. All operations are simultaneous. All the operator has to do is keep the stock reel supplied with stock and remove boxes of finished work. One operator can keep a dozen or more machines going.

Write for descriptive bulletin.

THE
H.E. HARRIS
ENGINEERING
COMPANY

MARK
OF
QUALITY



SYMBOL
OF
SERVICE

"The Bridgeport Tool Shop"
BRIDGEPORT, CONN.

Callipers, Micrometer

Almond, T. R., Mfg. Co., 2 Maple Ave., Ashburnham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Goodell-Pratt Co., Greenfield, Mass.
Slocumb Co. J. T., Providence, R. I.
Starrett Co. L. S., Athol, Mass.

Cams

American Mch. & Foundry Co., 5520 Second Ave., Brooklyn, N. Y.
Boston Gear Works, Norfolk Downs, Mass.
Garvin Mch. Co., Spring and Varick Sts., New York.
Rowbottom Mch. Co., Waterbury, Conn.

Cars, Industrial

Chase Foundry & Mfg. Co., Columbus, O.

Cartridge Machinery

Blackall, Frederick S., Woolworth Tower, New York.

Case-hardening

Kasnit Co., 11 Water St., New York.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston, Mass.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

Case-hardening Compound

Kasnit Co., 11 Water St., New York.

Case-hardening Furnaces

See Furnaces, Case-hardening.

Castings, Brass, Bronze and Aluminum

Light Mfg. & Foundry Co., Pottstown, Pa.
Lumen Bearing Co., Buffalo, N. Y.
Newman Mfg. Co., Cincinnati, O.
Titanium Alloy Mfg. Co., Buffalo, N. Y.

Castings, Die or Die-Molded

Acme Die-Casting Corporation, Bush Terminal No. 5, 35th St. and 3rd Ave., Brooklyn, N. Y.
Doehler Die-Casting Co., Court and Ninth Sts., Brooklyn, N. Y.

Franklin Mfg. Co., 738 Gifford St., Syracuse, N. Y.

Light Mfg. & Foundry Co., Pottstown, Pa.

Lumen Bearing Co., Buffalo, N. Y.

Moberg, C. J., Inc., Mt. Vernon, N. Y.

Newman Mfg. Co., Cincinnati, O.

Ohmer Fare Register Co., Dayton, O.

Phoenix Die-Casting Co., Buffalo, N. Y.

Precision Die-Casting Co., Syracuse, N. Y.

Stewart Mfg. Co., Wells St. Bridge, Chicago, Ill.

Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn.

West Steel Casting Co., Cleveland, O.

Cresson-Morris Co., Philadelphia, Pa.

West Steel Casting Co., Cleveland, O.

Castings, Nichrome

Driver-Harris Co., Harrison, N. J.

Centering Machines

Hendey Mch. Co., Torrington, Conn.

Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.

Niles-Bement-Pond Co., 111 Broadway, New York.

Porter-Cable Mch. Co., Syracuse, N. Y.

Pratt & Whitney Co., Hartford, Conn.

Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.

Wells & Son Co., F. E., Greenfield, Mass.

Whitton Mch. Co., D. E., New London, Conn.

Centers, Planer and Miller

Bickford Mch. Co., Greenfield, Mass.

Cincinnati Planer Co., Cincinnati, O.

Morse Twist Drill & Machine Co., New Bedford, Mass.

Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.

Chain Blocks

See Hoists, Chain, etc.

Chains, Driving, Etc.

Baldwin Chain & Mfg. Co., Worcester, Mass.

Boston Gear Works, Norfolk Downs, Mass.

Diamond Chain & Mfg. Co., 240 W. Georgia St., Indianapolis, Ind.

Fraser & Co., Inc., Peter A., 417 Canal St., New York.

Link-Belt Co., Chicago, Ill.

Morse Chain Co., Ithaca, N. Y.

Union Chain & Mfg. Co., Sec. O.

Whitney Mfg. Co., Hartford, Conn.

Woburn Gear Works, Woburn, Mass.

Checks, Time, Tool and Pay

Matthews & Co., Jas. H., 3946 Forbes Field, Pittsburgh, Pa.

Noble & Westbrook Mfg. Co., Hartford, Conn.

Schwerdtle Stamp Co., Bridgeport, Conn.

Chucking Machines, Automatic and Semi-Automatic

See also Lathes, Turret.

Cleveland Automatic Machine Co., Cleveland, O.

Gisholt Mch. Co., Madison, Wis.

National Acme Co., Cleveland, O.

New Britain Mch. Co., New Britain, Conn.

Potter & Johnston Mch. Co., Pawtucket, R. I.

Chucking Machines, Multiple Spindle, Automatic

New Britain Mch. Co., New Britain, Conn.

Chucks, Air

Bardons & Oliver, Cleveland, O.

Garvin Mch. Co., Spring and Varick Sts., New York.

Hannifin Mfg. Co., Chicago, Ill.

Manufacturers Equipment Co., 175 N. Jefferson St., Chicago, Ill.

Chucks, Drill

Almond Mfg. Co., T. R., 2 Maple Ave., Ashburnham, Mass.

Cleveland Twist Drill Co., Cleveland, O.

Cushman Chuck Co., Hartford, Conn.

Detroit Twist Drill Co., Detroit, Mich.

Goodell-Pratt Co., Greenfield, Mass.

Greenfield Tap & Die Corp., Greenfield, Mass.

Horton & Son Co., E., Windsor Locks, Conn.

Jacobs Mfg. Co., Hartford, Conn.

McCroskey Reamer Co., Meadville, Pa.

Millers Falls Co., Millers Falls, Mass.

Modern Tool Co., 21 and State Sts., Erie, Pa.

Montgomery & Co., Inc., 104 Fulton St., New York.

Morse Twist Drill & Machine Co., New Bedford, Mass.

Narragansett Mch. Co., Providence, R. I.

National Twist Drill & Tool Co., Detroit, Mich.

Newman Mfg. Co., Cincinnati, O.

Oneida National Chuck Co., Oneida, N. Y.

Skinner Chuck Co., New Britain, Conn.

Standard Tool Co., Inc., 16 W. 61st St., New York.

Swedish Gauge Co., Wilmington, Del.

Trump Bros. Mch. Co., New Britain, Conn.

Waterston, J. M., Detroit, Mich.

Westcott Chuck Co., Oneida, N. Y.

Whitton Mch. Co., D. E., New London, Conn.

Chucks, Lathe, Etc.

Cushman Chuck Co., Hartford, Conn.
Gisholt Mch. Co., Madison, Wis.
Hardinge Bros., Inc., Berteau & Ravenswood Aves., Chicago, Ill.

Hoggson & Pettis Mfg. Co., New Haven, Conn.

Horton & Son Co., E., Windsor Locks, Conn.

McCroskey Reamer Co., Meadville, Pa.

Montgomery & Co., Inc., 104 Fulton St., New York.

Newman Mfg. Co., Cincinnati, O.

Oneida National Chuck Co., Oneida, N. Y.

Rivett Lathe & Grinder Co., Brighton District, Boston, Mass.

Skinner Chuck Co., New Britain, Conn.

Thomas Elevator Co., 22 S. Hoyne Ave., Chicago, Ill.

Union Mfg. Co., New Britain, Conn.

Westcott Chuck Co., Oneida, N. Y.

Whitton Mch. Co., D. E., New London, Conn.

Chucks, Magnetic

D & W Fuse Co., Providence, R. I.

Heald Mch. Co., 20 New Bond St., Worcester, Mass.

Walker Co., O. S., Worcester, Mass.

Chucks, Planer

Cincinnati Planer Co., Cincinnati, O.

Cushman Chuck Co., Hartford, Conn.

Hoggson & Pettis Mfg. Co., New Haven, Conn.

Horton & Son Co., E., Windsor Locks, Conn.

Skinner Chuck Co., New Britain, Conn.

Union Mfg. Co., New Britain, Conn.

Chucks, Tapping

Beaman & Smith Co., Providence, R. I.

Bicknell-Thomas Co., Greenfield, Mass.

Errington Mechanical Laboratory, 39 Cortlandt St., New York.

Greenfield Tap & Die Corp., Greenfield, Mass.

McCroskey Reamer Co., Meadville, Pa.

Millholland Mch. Co., W. K., Indianapolis, Ind.

Newman Mfg. Co., Cincinnati, O.

Peter Bros. Mfg. Co., 135 Railroad Ave., Algonquin, Ill.

Procurier, Wm. L., 549 Washington Blvd., Chicago, Ill.

Scully-Jones & Co., 647 Railway Exchange, Chicago, Ill.

Circuit Breakers

D & W Fuse Co., Providence, R. I.

General Electric Co., Schenectady, N. Y.

Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Clamps

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.

Bealy & Co., Chas. H., 120-B N. Clinton St., Chicago, Ill.

Billings & Spencer Co., Hartford, Conn.

Brown & Sharpe Mfg. Co., Providence, R. I.

Goodell-Pratt Co., Greenfield, Mass.

Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.

Hannifin Mfg. Co., Chicago, Ill.

Starrett Co., L. S., Athol, Mass.

Western Tool & Mfg. Co., Springfield, O.

Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

Clamps, Pipe

National Tube Co., Pittsburgh, Pa.

Clocks, Watchmen's

Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago, Ill.

Clutches, Friction, Etc.

Bicknell-Thomas Co., Greenfield, Mass.

Brown Clutch Co., Sandusky, O.

Brown Engineering Co., 133 N. 3d St., Reading, Pa.

Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago, Ill.

Conway & Co., Cincinnati, O.

Cresson-Morris Co., Philadelphia, Pa.

Edgemont Mch. Co., 2700 National Ave., Dayton, O.

Johnson Mch. Co., Carlyle, Manchester, Conn.

Link-Belt Company, Chicago, Ill.

Moore & White Co., 2707-2737 N. 15th St., Philadelphia, Pa.

Reliance Gauge Column Co., 6008 Carnegie Ave., Cleveland, O.

Wood Sons Co., T. B., Chambersburg, Pa.

Collars, Safety

Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.

Brown Co., A. & F., 79 Barclay St., New York.

Link-Belt Company, Chicago, Ill.

Safety Emery Wheel Co., Springfield, O.

Standard Pressed Steel Co., Philadelphia, Pa.

Collars, Spacing, Etc.

Detroit Stamping Co., Detroit, Mich.

Scully-Jones & Co., 647 Railway Exchange, Chicago, Ill.

Collets, Spring

See Chucks, etc.

Ames Co., B. C., Waltham, Mass.

Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago, Ill.

Rivett Lathe & Grinder Co., Brighton, Boston, Mass.

Commutators

Wagner Elec. Mfg. Co., St. Louis, Mo.

Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Compound, Cleaning

Oakley Chemical Co., 26 Thames St., New York.

Compound, Cutting, Grinding, Etc.

Cataract Refining & Mfg. Co., Buffalo, N. Y.

Fiske Bros. Refining Co., 24 State St., New York.

Hawa, Inc., Geo. A., 135 Front St., New York.

Oakley Chemical Co., 26 Thames St., New York.

Stuart & Co., Inc., D. A., 29 So. La Salle St., Chicago, Ill.

Compressors, Air and Gas

Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill.

Curtis Pneumatic Mch. Co., 1568 Kienlen Ave., St. Louis, Mo.

General Electric Co., Schenectady, N. Y.

Ingersoll-Rand Co., 11 Broadway, New York.

Worthington Pump & Mch. Corp., 115 Broadway, New York.

Conduits

General Electric Co., Schenectady, N. Y.

Contract Work

American Mch. & Foundry Co., 5520 Second Ave., Brooklyn, N. Y.

American Tool & Mfg. Co., Urbana, O.

Automat Tool Works, 262 Greenwich St., New York.

Carroll Engineering Co., Dayton, O.

Columbus Die, Tool & Mch. Co., Columbus, O.

Fox Gun Co., A. H., Philadelphia, Pa.

Gisholt Mch. Co., Madison, Wis.

Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill.

Harris Engineering Co., H. E., Bridgeport, Conn.

Himoff Mch. Co., 45 Mills St., Astoria, N. Y.

Ingle Mch. Co., Rochester, N. Y.

Krasberg Mfg. Co., 412 Orleans St., Chicago, Ill.

Langelier Mfg. Co., Providence, R. I.

Marvin Mfg. Co., W. B., Urbana, O.

Mante & Sons, J., Buffalo, N. Y.

Mehl Mch. Tool & Die Co., Roselle, N. J.

Meisel Press Mfg. Co., 948 Dorchester Ave., Boston, Mass.

Moore-Eastwood Mfg. Co., Dayton, O.

Nelson Tool Co., Inc., 781-783 E. 142d St., New York.

New Britain Mch. Co., New Britain, Conn.

North Side Tool Works, Dayton, O.

Ohmer Fare Register Co., Dayton, O.

Poole Engineering & Mch. Co., Baltimore, Md.

Rockford Metal Specialty Co., Rockford, Ill.

Sloan & Chace Mfg. Co., Ltd., Newark, N. J.

Slocum, Avram & Slocum Laboratories, Inc., 531 W. 21st St., New York.

Smalley-General Co., Bay City, Mich.

Solar Metal Products Co., Inc., Columbus, O.

S-P Mfg. Co., Cleveland, O.

Steel Products Engineering Co., Springfield, O.

Steiner Bros., Lima, O.

Taft-Peirce Mfg. Co., Woonsocket, R. I.

Taylor Mch. Co., Cleveland, O.

Taylor-Shantz Co., Rochester, N. Y.

T. C. M. Mfg. Co., Harrison, N. J.

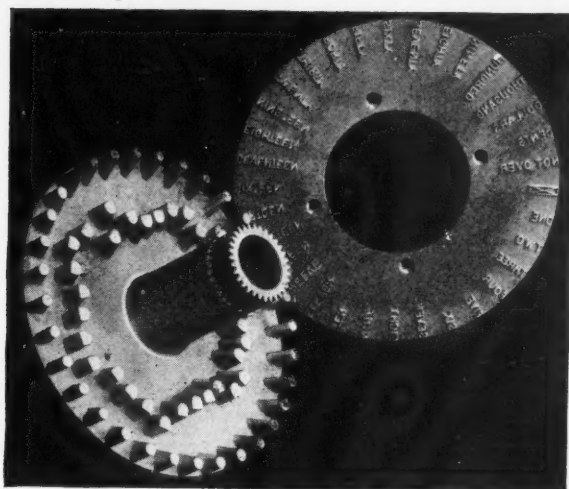
Ulmer Co., J. C., Cleveland, O.

Urbana Tool & Die Co., Urbana, O.

Controllers

Eck Dynamo & Motor Co., Belleville, N. J.

General Electric Co., Schenectady, N. Y.



Doehler Die-Cast Check Protector Parts

DOEHLER DIE-CASTINGS

With labor at a premium and with the prevailing difficulty of obtaining machine tools, Doehler Die-Castings, requiring the use of but a minimum of labor and little if any machine equipment, have been of material help in solving the production problems for some of the leading manufacturing concerns in the country. This has been accomplished most satisfactorily from standpoints of **EFFICIENCY** as well as **ECONOMY**.

DOEHLER DIE-CASTING CO.

MAIN OFFICE AND EASTERN PLANT

BROOKLYN, N.Y.WESTERN PLANT
TOLEDO, OHIO.NEW JERSEY PLANT
NEWARK, N.J.

Die-Castings in Brass and Bronze, Aluminum, and White Metal Alloys.
Die-Cast Babbitt and Babbitt-lined Bronze Bearings.

The Gripping Power of Universal Giant Compression Couplings

Imagine a compression grip that will hold even when the load puts a permanent set in the shaft. That's what the Giant Compression Coupling has actually done.

It is a keyless coupling, so simple, so efficient, and so easy to attach that it has remained the favorite for over thirty-eight years. Three of the original couplings made in 1876 are still in use and apparently as good as ever.

More dealers carry Universal Giant Couplings and more of them are sold than any other type.

Bulletin describes them fully. Catalog shows complete line of Power Transmission Appliances.

W. B. WOOD
SONS CO.



T. B. WOOD SONS COMPANY, Chambersburg, Pa.

Makers of the most complete line of Power Transmission Machinery made by any one Manufacturer

Cranes, Electric Traveling

Biggs-Watterson Co., Cleveland, O.
Box & Co., Alfred, Philadelphia, Pa.
Northern Engineering Works, Detroit, Mich.
Shaw Electric Crane Co., Muskegon, Mich.

Cranes, Electric Truck

General Electric Co., Schenectady, N. Y.

Cranes, Locomotive

Link-Belt Company, Chicago, Ill.

Cranes, Portable

Canton Fdry. & Mch. Co., Canton, O.

Crank Pin Turning Machines

American Tool Works Co., Cincinnati, O.
LeBlond Mch. & Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pedrick Tool & Mch. Co., 3639 N. Lawrence St., Philadelphia, Pa.
Underwood & Co., H. B., Philadelphia, Pa.

Crucibles

Dixon Crucible Co., Joseph, Jersey City, N. J.

Cutters, Milling

Adams Co., Dubuque, Iowa.
Advance Tool Co., Cincinnati, O.
Barber-Colman Co., Rockford, Ill.
Becker Milling Mch. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Milling Mch. Co., Cleveland, O.
Cleveland Twist Drill Co., Cleveland, O.
Detroit Twist Drill Co., Detroit, Mich.
Goddard Tool Co., Chicago, Ill.
Gould & Eberhardt, Newark, N. J.
Harris Engineering Co., H. E., Bridgeport, Conn.
Illinois Tool Works, Chicago, Ill.
Ingersoll Milling Machine Co., Rockford, Ill.
Kearney & Trecker Co., Milwaukee, Wis.
Krasberg Mfg. Co., 412 Orleans St., Chicago, Ill.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Michigan Tool Co., Detroit, Mich.
National Tool Co., Cleveland, O.
National Twist Drill & Tool Co., Detroit, Mich.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Reliance Steel & Tool Co., Inc., 30 Church St., New York.
Standard Tool Co., Cleveland, O.
T. C. M. Mfg. Co., Harrison, N. J.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Conn.
Windau Tool Co., Cleveland, O.

Cutting Compound

See Compound, Cutting, Grinding, etc.

Cutting-off Machines, Abrasive Wheel

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
Nutter & Barnes Co., Hinsdale, N. H.
Peter Bros. Mfg. Co., Algonquin, Ill.

Cutting-off Machines, Cold Saw

See Saws, Rotary Machines.

Cutting-off Machines, Rotary

Brown & Sharpe Mfg. Co., Providence, R. I.
Curtis & Curtis Co., 8 Garden St., Bridgeport, Conn.
Davis Mch. Tool Co., Inc., Rochester, N. Y.
Etna Mch. Tool Co., Toledo, O.
Fawcett Mch. Co., Pittsburgh, Pa.
Hurlbut, Rogers Mch. Co., So. Sudbury, Mass.
Modern Mch. Tool Co., Jackson, Mich.
Treadwell Engineering Co., Easton, Pa.

Cutting-off Tools

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.
Ready Tool Co., Bridgeport, Conn.
Western Tool & Mfg. Co., Springfield, O.

Cyclometers

Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn.

Cylinder Bore

See Boring and Drilling Machines, Vertical.
Beaman & Smith Co., Providence, R. I.
Underwood & Co., H. B., Philadelphia, Pa.

Cylinder Boring Machines, Portable

Pedrick Tool & Mch. Co., 3639 N. Lawrence St., Philadelphia, Pa.

Demagnetizers

D & W Fuse Co., Providence, R. I.
Heald Mch. Co., 20 New Bond St., Worcester, Mass.
Walker Co., O. S., Worcester, Mass.

Die Blocks

Dyson & Sons, Jos., Cleveland, O.

Die Castings

See Castings, Die or Die-molded.

Die Milling Machines

Anderson Die Machine Co., Bridgeport, Conn.
Billings & Spencer Co., Hartford, Conn.

Die Sinking Machines

Jackson Mch. Tool Co., Jackson, Mich.
Pratt & Whitney Co., Hartford, Conn.
Walcott Lathe Co., Jackson, Mich.

Die Stocks

Armstrong Mfg. Co., 297 Knowlton St., Bridgeport, Conn.

Bay State Tap & Die Co., Mansfield, Mass.

Billings & Spencer Co., Hartford, Conn.

Brubaker & Bros., W. L., Millersburg, Pa.

Butterfield & Co., Derby Line, Vermont.

Card Mfg. Co., S. W., Mansfield, Mass.

Carpenter Tap & Die Co., J. M., Pawtucket, R. I.

Curtis & Curtis Co., Bridgeport, Conn.

Greenfield Tap & Die Corp., Greenfield, Mass.

Hart Mfg. Co., E. 20th St. and Marion Ave., Cleveland, O.

Morse Twist Drill & Mch. Co., New Bedford, Mass.

Pratt & Whitney Co., Hartford, Conn.

Reed Mfg. Co., Erie, Pa.

Saunders Sons, D., Yonkers, N. Y.

Standard Engineering Co., Ellwood City, Pa.

Walworth Mfg. Co., Boston, Mass.

Wells & Son Co., F. E., Greenfield, Mass.

Dies, Lettering and Embossing

Matthews & Co., Jas. H., 3946 Forbes Field, Pittsburgh, Pa.
Maute & Sons, J., Buffalo, N. Y.
Noble & Westbrook Mfg. Co., Hartford, Conn.
Schwerdtle Stamp Co., Bridgeport, Conn.

Dies, Sheet Metal, Etc.

Acklin Stamping Co., 1637 Dorr St., Toledo, O.
American Mch. & Foundry Co., 5520 2nd Ave., Brooklyn, N. Y.
American Tool & Mfg. Co., Urbana, O.
Automat Tool Works, 252 Greenwich St., New York.
Bliss Co., E. W., 5 Adams St., Brooklyn, N. Y.
Cleveland Mch. & Mfg. Co., 4944 Hamilton Ave., Cleveland, O.
Columbus Die, Tool & Mch. Co., Columbus, O.
Ferracute Mch. Co., Bridgeton, N. J.
Goddard Tool Co., Chicago, Ill.
Harris Engineering Co., H. E., Bridgeport, Conn.
Krasberg Mfg. Co., 412 Orleans St., Chicago, Ill.
Lansing Stamping & Tool Co., Lansing, Mich.
Marvin Mfg. Co., W. B., Urbana, O.
Maute & Sons, J., Buffalo, N. Y.
Mehl Mch. Tool & Die Co., Roselle, N. J.
Michigan Tool Co., Detroit, Mich.
Middlesex Mch. Wks., Middletown, Conn.
Modern Tool, Die & Machine Co., Columbus, O.
Moore-Eastwood Mfg. Co., Dayton, O.
Nelson Tool Co., Inc., 781-783 E. 142nd St., New York.
Pratt & Whitney Co., Hartford, Conn.
Rockford Metal Specialty Co., Rockford, Ill.
Sloan & Chase Mfg. Co., Ltd., Newark, N. J.
Slocum, Avram & Slocum Laboratories, Inc., 531 W. 21st St., New York.
Solar Metal Products Co., Inc., Columbus, O.
Swaine Mfg. Co., F. J., St. Louis, Mo.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Taylor-Shantz Co., Rochester, N. Y.
Ulmer Co., J. C., Cleveland, O.
Urbana Tool & Die Co., Urbana, O.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening

Butterfield & Co., Derby Line, Vt.
Errington Mechanical Laboratory, 39 Cortlandt St., New York.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Ideal Tool & Mfg. Co., Beaver Falls, Pa.
Jones & Lamson Mch. Co., Springfield, Vt.
Landis Mch. Co., Inc., Waynesboro, Pa.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Murphy Mch. & Tool Co., 34 Porter St., Detroit, Mich.
National Acme Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Conn.
Rickert-Shafer Co., Erie, Pa.

Drafting Machines

Keuffel & Esser Co., Hoboken, N. J.

Draw Benches

Roux & Heyberger, 108 Rue Lafayette, Paris, France.

Drawing Boards and Tables

Economy Drawing Table Co., Toledo, O.
Keuffel & Esser Co., Hoboken, N. J.
New Britain Mch. Co., New Britain, Conn.

Drawing Materials

Keuffel & Esser Co., Hoboken, N. J.

Dressers, Grinding Wheel

Abrasive Co., Bridesburg, Philadelphia, Pa.
American Emery Wheel Works, Providence, R. I.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Calder, Geo. H., Lancaster, Pa.
Desmond-Stephan Mfg. Co., Urbana, O.
Hetherington-McCabe Co., Piqua, O.
Norton Co., Worcester, Mass.
Reed Mfg. Co., Erie, Pa.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Sterling Grinding Wheel Co., Tiffin, O.
Vitrified Wheel Co., Westfield, Mass.
Western Tool & Mfg. Co., Springfield, O.

Drill Heads, Multiple

Baush Mch. Tool Co., 200 Wason Ave., Springfield, Mass.
Covington Multiple Drill Co., Cincinnati, O.
Medina Mch. Co., Medina, O.
National Automatic Tool Co., Richmond, Ind.
Newman Mfg. Co., Cincinnati, O.
Rockford Drilling Mch. Co., Rockford, Ill.
Sellew Mch. Tool Co., Pawtucket, R. I.

Drill Sockets

Cleveland Twist Drill Co., Cleveland, O.
Detroit Twist Drill Co., Detroit, Mich.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Scully-Jones & Co., 647 Railway Exchange Bldg., Chicago, Ill.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.

Drill Speeders

Graham Mfg. Co., Providence, R. I.
Peter Bros. Mfg. Co., 135 Railroad Ave., Algonquin, Ill.

Drill Stands

Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.

Drilling Machines, Automatic

Baker Bros., Toledo, O.

Drilling Machines, Bench

Ames Co., B. C., Waltham, Mass.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Blomist-Eck Mch. Co., Cleveland, O.
Buffalo Forge Co., Buffalo, N. Y.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Hisey-Wolf Mch. Co., Cincinnati, O.
Langelier Mfg. Co., Providence, R. I.
Leland-Gifford Co., Worcester, Mass.
National Automatic Tool Co., Richmond, Ind.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Co., F. E., Reed Dept. and Prentice Bros. Dept., Worcester, Mass.
Rockford Drilling Mch. Co., Rockford, Ill.
Taylor & Fenn Co., Hartford, Conn.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.

Drilling Machines, Boller

Cincinnati Bickford Tool Co., Oakley, Cincinnati, O.
Foote-Burt Co., Cleveland, O.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Drilling Machines, Portable Electric

Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark Electric Co., Inc., Jas. Jr., Louisville, Ky.

Errington Mechanical Laboratory, 39 Cortlandt St., New York.

Hisey-Wolf Mch. Co., Cincinnati, O.
Independent Pneumatic Tool Co., Chicago, Ill.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.

Neil & Smith Elec. Tool Co., Cincinnati, O.
Standard Electric Tool Co., Cincinnati, O.
Stow Mfg. Co., Binghamton, N. Y.

United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.
Van Dora Electric Tool Co., Cleveland, O.

Drilling Machines, Horizontal, Duplex

Garvin Mch. Co., Spring and Varick Sts., New York.
Langelier Mfg. Co., Providence, R. I.

Drilling Machines, Multiple Spindle, Adjustable

Baush Mch. Tool Co., 200 Wason Ave., Springfield, Mass.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Langelier Mfg. Co., Providence, R. I.
National Automatic Tool Co., Richmond, Ind.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Multiple Spindle, Horizontal

Baush Mch. Tool Co., 200 Wason Ave., Springfield, Mass.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Langelier Mfg. Co., Providence, R. I.
Moline Tool Co., Moline, Ill.
National Acme Co., Cleveland, O.

Drilling Machines, Multiple Spindle, Turret

Langelier Mfg. Co., Providence, R. I.
National Automatic Tool Co., Richmond, Ind.
Newman Mfg. Co., Cincinnati, O.
Quint, A. E., Hartford, Conn.
Turner Mch. Co., Danbury, Conn.

Drilling Machines, Multiple Spindle, Vertical

Baker Bros., Toledo, O.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Cincinnati Bickford Tool Co., Oakley, Cincinnati, O.
Cincinnati Pulley Mch. Co., Cincinnati, O.
Clark Electric Co., Inc., Jas. Jr., Louisville, Ky.
Colburn Mch. Tool Co., Franklin, Pa.
Foote-Burt Co., Cleveland, O.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Langelier Mfg. Co., Providence, R. I.
Leland-Gifford Co., Worcester, Mass.
Medina Mch. Co., Medina, O.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Richmond, Ind.
Newton Mch. Tool Wks., Inc., 23rd and Vine Sts., Philadelphia, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. E., Hartford, Conn.
Reed Co., Francis, 43 Hammond St., Worcester, Mass.
Reed-Prentice Co., F. E., Reed Dept. and Prentice Bros. Dept., Worcester, Mass.
Rockford Drilling Mch. Co., Rockford, Ill.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Silver Mfg. Co., Salem, O.
Sipp Mch. Co., Paterson, N. J.
Taylor & Fenn Co., Hartford, Conn.
Taylor Mch. Co., Cleveland, O.

Drilling Machines, Pneumatic

Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York.

Drilling Machines, Radial

American Tool Works Co., Cincinnati, O.
Canedy-Otto Mfg. Co., Chicago Heights, Ill.
Carlton Mch. Tool Co., Cincinnati, O.
Cincinnati Bickford Tool Co., Oakley, Cincinnati, O.
Drees Mch. Tool Co., Cincinnati, O.
Fosdick Mch. Tool Co., Cincinnati, O.
Hammond Mfg. Co., Cleveland, O.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Morris Mch. Tool Co., Cincinnati, O.
Mueller Mch. Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., 111 Broadway, New York.
Reed-Prentice Co., F. E., Reed Dept. and Prentice Bros. Dept., Worcester, Mass.
Roux & Heyberger, 108 Rue Lafayette, Paris, France.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Taylor & Fenn Co., Hartford, Conn.

Drilling Machines, Rail

Colburn Mch. Tool Co., Franklin, Pa.
Foote-Burt Co., Cleveland, O.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Moline Tool Co., Moline, Ill.
Newton Mch. Tool Wks., Inc., 23rd and Vine Sts., Philadelphia, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Taylor & Fenn Co., Hartford, Conn.

Drilling Machines, Sensitive

Albany Hardware Specialty Mfg. Co., Albany, Wis.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Bilton Mch. Tool Co., Bridgeport, Conn.
Cincinnati Pulley Mch. Co., Cincinnati, O.
De Mooy Mch. Co., Cleveland, O.
Gardam & Son, Inc., Wm., 108 Park Place, New York.
Hammond Mfg. Co., Cleveland, O.
Henry & Wright Mfg. Co., Hartford, Conn.
Johnson Mch. Tool Co., Gouverneur, N. Y.
Langelier Mfg. Co., Providence, R. I.
Leland-Gifford Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., Francis, 43 Hammond St., Worcester, Mass.
Reed-Prentice Co., F. E., Reed Dept. and Prentice Bros. Dept., Worcester, Mass.
Roversford Foundry & Mch. Co., 54 N. 5th St., Philadelphia, Pa.
Sibley Mch. Co., 8 Tutt St., South Bend, Ind.
Sipp Machine Co., Paterson, N. J.
Taylor & Fenn Co., Hartford, Conn.

Drilling Machine Spacing Attachment, Universal

Medina Mch. Co., Medina, O.

Drilling Machines, Upright

Albany Hardware Specialty Mfg. Co., Albany, Wis.
Aurora Tool Works, Aurora, Ind.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.



**"Here it is,
Gentlemen!"**

Here is the SERVICE you want in a Lathe.

You get it co-mingled with SIDNEY.

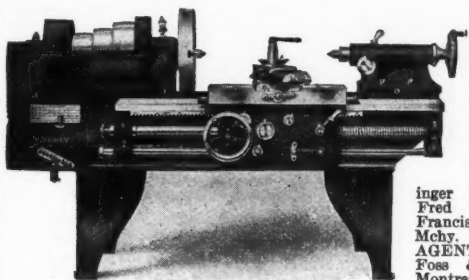
Sidney also stands for Speed—and Satisfaction.

We bring this "SIDNEY FOR SERVICE" label to your attention month after month because it is the visible indication of a superior machine. It is a protective mark. It is our guarantee that the Company stands behind every Sidney Lathe. It's the sterling mark on a Lathe. And it has become that in the space of a few years of remarkable service.

Write for Particulars. Get Bulletin 32 now.

THE SIDNEY TOOL CO. SIDNEY, OHIO

The following firms handle Sidney Lathes:



AGENTS IN THE UNITED STATES:
Strong, Carlisle & Hammond Co., Cleveland, Ohio.
Marshall & Huschart Mch. Co., Chicago, Ill.
J. J. McCabe, New York City.
Frank Toomey Co., Philadelphia, Pa.
Vonnegut Mch. Co., Indianapolis, Ind.
Chas. Strelinger Co., Detroit, Mich.
Fred Ward & Son, San Francisco, Cal.
Portland Mch. Co., Portland, Ore.
AGENTS IN CANADA:
Foss & Hill Mch. Co., Montreal, Quebec.
H. W. Petrie, Ltd., Toronto, Ont.

ETNA SWAGER No. 2

This little machine is designed for ordinary small swaging and can be used on any class of work without the least danger of warping or straining.

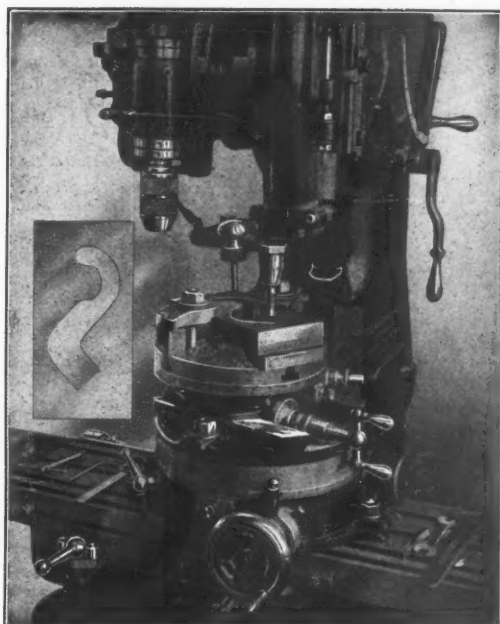
The distinguishing characteristic of operation is economy—high working speed, moderate die costs and low power consumption being the factors most directly responsible. The machine is heavily built; in every respect fully up to the high standards of all Etna machines.



Capacity, 1" diameter.

Write for Circular.

THE ETNA MACHINE CO.
Maplewood Avenue and Castle Blvd., TOLEDO, OHIO, U. S. A.



Cochrane-Bly Universal Shaper

This machine is a universal *precision* tool, and while it is designed with reference to minimizing cost on dies, jigs, tools, metal patterns, etc., requiring accurate finish, it is also well adapted to machining internal and external cams, gears, ratchets, etc., or for broaching blind holes and cutting keyways or similar work hard to perform except with special equipment.

As an illustration of the usefulness of the machine on certain productive work, one of same has recently been installed by a prominent manufacturer having a large contract for aeroplane gears with taper holes, the shaper being used for cutting the keyways at the desired angle and with the *accuracy required*. Many of these gears have two or more keyways.

Construction is substantial, all control and adjustments are convenient to the operator, and there is ample power for heavy cuts. *

Complete description in catalog.

Cochrane-Bly Co.
ROCHESTER NEW YORK

FOREIGN AGENTS: James Say, 184 Wilmslow Road, Manchester, England, for Great Britain and Ireland. Fenwick Freres & Co., Paris, for France, Italy, Belgium, Switzerland, Spain and Portugal. H. P. Gregory & Company, Sydney, for Australia.

Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
 Beaman & Smith Co., Providence, R. I.
 Bilton Mch. Tool Co., Bridgeport, Conn.
 Buffalo Forge Co., Buffalo, N. Y.
 Canedy-Otto Mfg. Co., Chicago Heights, Ill.
 Cincinnati Bickford Tool Co., Oakley, Cincinnati, O.
 Cincinnati Pulley Mch. Co., Cincinnati, O.
 Colburn Mch. Tool Co., Franklin, Pa.
 Davis Mch. Tool Co., Inc., Rochester, N. Y.
 Foote-Burt Co., Cleveland, O.
 Foodick Mch. Tool Co., Cincinnati, O.
 Garvin Mch. Co., Spring and Varick Sts., New York.
 Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
 Henry & Wright Mfg. Co., Hartford, Conn.
 Knight Mch. Co., W. B., 2019 Lucas Ave., St. Louis, Mo.
 Langelier Mfg. Co., Providence, R. I.
 Leland-Gifford Co., Worcester, Mass.
 Lindgren Co., F. W., Rockford, Ill.
 Minster Mch. Co., Minster, O.
 Moline Tool Co., Moline, Ill.
 Niles-Bement-Pond Co., 111 Broadway, New York.
 Pratt & Whitney Co., Hartford, Conn.
 Reed Co., Francis, 43 Hammond St., Worcester, Mass.
 Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass.
 Rockford Drilling Mch. Co., Rockford, Ill.
 Sellers & Co., Inc., Wm., Philadelphia, Pa.
 Sibley Mch. Co., 8 Tutt St., South Bend, Ind.
 Sipp Machine Co., Paterson, N. J.
 Snyder & Son, J. E., Worcester, Mass.
 Standard Mfg. Co., Bridgeport, Conn.
 Taylor & Fenn Co., Hartford, Conn.

Drilling Machines, Wall Radial

Canedy-Otto Mfg. Co., Chicago Heights, Ill.

Drills, Center

Cleveland Twist Drill Co., Cleveland, O.
 Detroit Twist Drill Co., Detroit, Mich.
 Morse Twist Drill & Machine Co., New Bedford, Mass.
 National Twist Drill & Tool Co., Detroit, Mich.
 Pratt & Whitney Co., Hartford, Conn.
 Slocumb Co., J. T., Providence, R. I.
 Standard Tool Co., Cleveland, O.

Drills, Ratchet

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
 Billings & Spencer Co., Hartford, Conn.
 Cleveland Twist Drill Co., Cleveland, O.
 Detroit Twist Drill Co., Detroit, Mich.
 Goodell-Pratt Co., Greenfield, Mass.
 Greene, Tweed & Co., 109 Duane St., New York.
 Millers Falls Co., Millers Falls, Mass.
 National Twist Drill & Tool Co., Detroit, Mich.
 Pratt & Whitney Co., Hartford, Conn.
 Standard Tool Co., Cleveland, O.
 Walworth Mfg. Co., Boston, Mass.
 Whitman & Barnes Mfg. Co., 1000 West 120th St., Chicago, Ill.

Drills, Twist

Baker & Co., Inc., H., 101 Duane St., New York.
 Clark Equipment Co., Buchanan, Mich.
 Cleveland Twist Drill Co., Cleveland, O.
 Detroit Twist Drill Co., Detroit, Mich.
 Frasse & Co., Inc., Peter A., 417 Canal St., New York.
 Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
 Montgomery & Co., Inc., 104 Fulton St., New York.
 Morse Twist Drill & Machine Co., New Bedford, Mass.
 National Twist Drill & Tool Co., Detroit, Mich.
 Pratt & Whitney Co., Hartford, Conn.
 Reliance Steel & Tool Co., Inc., 30 Church St., New York.
 Standard Tool Co., Cleveland, O.
 Union Twist Drill Co., Athol, Mass.
 Whitman & Barnes Mfg. Co., 1000 West 120th St., Chicago, Ill.

Drinking Water Fountains and Systems

Allen Filter Co., Toledo, O.
 Manufacturing Equipment & Eng. Co., Framingham, Mass.

Dynamos

Eck Dynamo & Motor Co., Belleville, N. J.
 General Electric Co., Schenectady, N. Y.
 Reliance Electric & Eng. Co., 1056 Ivanhoe Road, Cleveland, O.
 Sprague Electric Works, 527 W. 34th St., New York.
 Wagner Electric Mfg. Co., St. Louis, Mo.
 Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Electrical Supplies

General Electric Co., Schenectady, N. Y.
 Wagner Elec. Mfg. Co., St. Louis, Mo.
 Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Elevators

Albro-Clem Elevator Co., 701 Glenwood Ave., Philadelphia, Pa.
 Link-Belt Company, Chicago, Ill.

Emery Wheels

See Grinding Wheels.

Emery Wheel Dressers

See Dressers, Grinding Wheel.

Engines, Steam

Bethlehem Steel Co., South Bethlehem, Pa.
 Buckeye Engine Co., Salem, O.
 Buffalo Forge Co., Buffalo, N. Y.

Expanders, Tube

Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.
 Watson-Stillman Co., 192 Fulton St., New York.

Expansion Joints

Nuttall Co., R. D., Pittsburgh, Pa.

Eye Protectors

Willson & Co., Inc., T. A., 3rd and Washington Sts., Reading, Pa.

Fans, Exhaust, Electric, Ventilating

Buffalo Forge Co., Buffalo, N. Y.
 Eck Dynamo & Motor Co., Belleville, N. J.
 General Electric Co., Schenectady, N. Y.
 Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Ferro Tungsten

Vanadium-Alloys Steel Co., Pittsburgh, Pa.

File Handles

Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
 Osgood Tool Co., J. L., Buffalo, N. Y.

Files

American Swiss File & Tool Co., 24 John St., New York.
 Barnett Co. G. & H., Philadelphia, Pa.
 Delta File Works, Philadelphia, Pa.
 Diston & Sons, Inc., Henry, Philadelphia, Pa.
 Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
 Montgomery & Co., Inc., 104 Fulton St., New York.
 Nicholson File Co., Providence, R. I.
 Reichhelm & Co., E. P., 24 John St., New York.
 Simonds Mfg. Co., Fitchburg, Mass.
 Walls Tool Co., T. P., 75 Walker St., New York.

Filing Machines, Die, Etc.

Ames Co., B. C., Waltham, Mass.
 Cochran-Bly Co., Rochester, N. Y.
 Oliver Instrument Co., Adrian, Mich.
 Rearwin, W. D., Grand Rapids, Mich.
 Robinson Tool Works, Inc., Waterbury, Conn.
 Waltham Machine Works, Waltham, Mass.

Fillet (Leather)

Graton & Knight Mfg. Co., Worcester, Mass.

Filters, Drinking Water

Allen Filter Co., Toledo, O.

Fittings, Steam, Hydraulic, Etc.

Dart Mfg. Co., E. M., Providence, R. I.
 Hydraulic Press Mfg. Co., 84 Lincoln Ave., Mt. Gilead, O.
 Metalwood Mfg. Co., Detroit, Mich.
 National Tube Co., Pittsburgh, Pa.
 Walworth Mfg. Co., Boston, Mass.
 Watson-Stillman Co., 192 Fulton St., New York.

Flexible Shafts

Chicago Flexible Shaft Co., 149 W. La Salle St., Chicago, Ill.
 Oliver Instrument Co., Adrian, Mich.
 Stow Mfg. Co., Binghamton, N. Y.

Flux, Welding

Gisholt Mch. Co., Madison, Wis.

Forges

Billings & Spencer Co., Hartford, Conn.
 Buffalo Dental Mfg. Co., Buffalo, N. Y.
 Buffalo Forge Co., Buffalo, N. Y.

Forging Machines

Acme Machinery Co., Cleveland, O.
 Ajax Mfg. Co., Cleveland, O.
 Reaudry & Co., Inc., Boston, Mass.
 Bliss Co., E. W., 5 Adams St., Brooklyn, N. Y.
 National Machinery Co., Tiffin, O.
 Roux & Heyberger, 108 Rue Lafayette, Paris, France.
 Williams, White & Co., Moline, Ill.

Forgings, Drop

Billings & Spencer Co., Hartford, Conn.
 Johnston & Jennings Co., Addison Road and Lake Shore R. R. Tracks, Cleveland, O.
 Whitman & Barnes Mfg. Co., 1000 West 120th St., Chicago, Ill.
 Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.
 Wyman-Gordon Co., Worcester, Mass.

Forgings, Iron and Steel

Camden Forge Co., Camden, N. J.
 Cleveland Mch. & Mfg. Co., 4944 Hamilton Ave., Cleveland, O.
 Cresson-Morris Co., Philadelphia, Pa.
 Dyson & Sons, Jos., Cleveland, O.
 Johnston & Jennings Co., Addison Road and Lake Shore R. R. Tracks, Cleveland, O.
 Machinery Forging Co., Cleveland, O.

Forming and Bending Machines

Raird Mch. Co., Bridgeport, Conn.
 Bliss Co., E. W., 5 Adams St., Brooklyn, N. Y.
 Shuster Co., F. B., New Haven, Conn.

Foundry Equipment

Adams Co., Dubuque, Iowa.
 Ingersoll-Rand Co., 11 Broadway, New York.
 New Britain Mch. Co., New Britain, Conn.
 Northern Engineering Works, Detroit, Mich.

Furnaces, Annealing, Hardening and Tempering

American Gas Furnace Co., 24 John St., New York.
 Bellevue Industrial Furnace Co., Detroit, Mich.
 Brown & Sharpe Mfg. Co., Providence, R. I.
 Brown Instrument Co., Philadelphia, Pa.
 Chicago Flexible Shaft Co., 149 W. La Salle St., Chicago, Ill.
 General Electric Co., Schenectady, N. Y.
 Hoskins Mfg. Co., 459 Lawton Ave., Detroit, Mich.
 Rockwell Co., W. S., 50 Church St., New York.
 Strong, Carlisle & Hammond Co., Cleveland, O.

Furnaces, Case-hardening

American Gas Furnace Co., 24 John St., New York.
 Brown & Sharpe Mfg. Co., Providence, R. I.
 Chicago Flexible Shaft Co., 149 W. La Salle St., Chicago, Ill.
 General Electric Co., Schenectady, N. Y.
 Strong, Carlisle & Hammond Co., Cleveland, O.

Furnaces, Electric

General Electric Co., Schenectady, N. Y.
 Hoskins Mfg. Co., 459 Lawton Ave., Detroit, Mich.

Furnaces, Heating

Billings & Spencer Co., Hartford, Conn.

Furnaces, Melting

American Gas Furnace Co., 24 John St., New York.
 Chicago Flexible Shaft Co., 149 W. La Salle St., Chicago, Ill.
 Strong, Carlisle & Hammond Co., Cleveland, O.

Furniture, Shop and Drafting-room

Economy Drawing Table Co., Toledo, O.
 Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
 Manufacturing Equipment & Eng. Co., Framingham, Mass.
 New Britain Mch. Co., New Britain, Conn.
 Western Tool & Mfg. Co., Springfield, O.

Gages, Ball

Atlas Ball Co., Glenwood Ave. at 4th St., Philadelphia, Pa.

Gages, Recording, Steam, Vacuum

Bristol Co., Waterbury, Conn.
 Brown Instrument Co., Philadelphia, Pa.
 Reliance Gauge Column Co., 6008 Carnegie Ave., Cleveland, O.

Gages, Surface, Depth, Dial, Snap, Etc.

Advance Tool Co., Cincinnati, O.
 Ames Co., B. C., Waltham, Mass.
 Automat Tool Works, 252 Greenwich St., New York.
 Brown & Sharpe Mfg. Co., Providence, R. I.
 Cleveland Twist Drill Co., Cleveland, O.
 Coats Mch. Tool Co., 30 Church St., New York.
 Fraser Co., Warren F., Boston, Mass.
 Gardam & Son, Inc., Wm., 108 Park Place New York.
 Goodard Tool Co., Chicago, Ill.
 Goodell-Pratt Co., Greenfield, Mass.
 Greenfield Tap & Die Corp., Greenfield, Mass.
 Harris Eng. Co., H. E., Bridgeport, Conn.
 Krasberg Mfg. Co., 412 Orleans St., Chicago, Ill.
 La Precision Mecanique, 11 Rue Vergniaud, Paris, France.
 Marvin Mfg. Co., W. B., Urbana, O.
 Mehl Mch. Tool & Die Co., Roselle, N. J.
 Moore-Eastwood Mfg. Co., Dayton, O.
 Morse Twist Drill & Machine Co., New Bedford, Mass.
 Pratt & Whitney Co., Hartford, Conn.
 Rogers Works, Inc., J. M., Gloucester City, N. J.
 Slocumb Co., J. T., Providence, R. I.
 Slocum, Avram & Slocum Laboratories, Inc., 531 W. 21st St., New York.
 S. P. Mfg. Co., Cleveland, O.
 Starrett Co. L. S., Athol, Mass.
 Swedish Gage Co., Inc., 16 W. 61st St., New York.
 Taft-Peirce Mfg. Co., Woonsocket, R. I.
 Taylor-Shantz Co., Rochester, N. Y.
 Ulmer Co., J. C., Cleveland, O.
 Union Tool Co., Orange, Mass.
 Vincent Steel Process Co., Detroit, Mich.

Gages, Universal Amplifying

North Side Tool Works, Dayton, O.

Galvanizing Machinery

Erie Foundry Co., Erie, Pa.

Gaskets

Graton & Knight Mfg. Co., Worcester, Mass.
 Greene, Tweed & Co., 109 Duane St., New York.

Gear Blanks, Bronze

Bunting Brass & Bronze Co., 748 Spencer St., Toledo, Ohio.
 Johnson Bronze Co., Newcastle, Pa.
 Light Mfg. & Foundry Co., Pottstown, Pa.
 Lumen Bearing Co., Buffalo, N. Y.
 Titanium Alloy Mfg. Co., Buffalo, N. Y.

Gear Cutting Machines, Bevel (Generator and Template Planer)

Bilgram Mch. Works, 1231 Spring Garden St., Philadelphia, Pa.
 Gleason Works, Rochester, N. Y.

Gear Cutting Machines, Bevel (Rotary Cutter)

Bilgram Mch. Tool Co., Bridgeport, Conn.
 Brown & Sharpe Mfg. Co., Providence, R. I.
 Flather Mfg. Co., E. J., Nashua, N. H.
 Gould & Eberhardt, Newark, N. J.
 Newark Gear Cutting Mch. Co., Newark, N. J.
 Whiton Mch. Co., D. E., New London, Conn.

Gear Cutting Machines, Helical and Spur (Hob)

Adams Co., Dubuque, Iowa.
 Barber-Colman Co., Rockford, Ill.
 Boston Gear Works, Norfolk Downs, Mass.
 Gould & Eberhardt, Newark, N. J.
 Himoff Mch. Co., 45 Mills St., Astoria, N. Y.
 Lees-Bradner Co., Cleveland, O.
 Meisselbach-Catucci Mfg. Co., 27 Congress St., Newark, N. J.
 Newark Gear Cutting Mch. Co., Newark, N. J.
 Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
 Reynolds Pattern & Mch. Co., Massillon, O.

Gear Cutting Machines, Helical and Spur (Shaper and Planer Type)

Bickett Mch. & Mfg. Co., Cincinnati, O.
 Fellows Gear Shaper Co., Springfield, Vt.
 Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.

Gear Cutting Machines, Spur (Rotary Cutter)

Bilgram Mch. Tool Co., Bridgeport, Conn.
 Brown & Sharpe Mfg. Co., Providence, R. I.
 Flather Mfg. Co., E. J., Nashua, N. H.
 Gould & Eberhardt, Newark, N. J.
 Newark Gear Cutting Mch. Co., Newark, N. J.
 Newton Mch. Tool Wks., Inc., 23rd and Vine Sts., Philadelphia, Pa.
 Waltham Mch. Works, Waltham, Mass.
 Whiton Mch. Co., D. E., New London, Conn.

Gear Cutting Machines, Worms and Worm Wheels (Hob)

Adams Co., Dubuque, Iowa.
 Barber-Colman Co., Rockford, Ill.
 Bilgram Mch. Tool Co., Bridgeport, Conn.
 Boston Gear Works, Norfolk Downs, Mass.
 Gould & Eberhardt, Newark, N. J.
 Himoff Mch. Co., 45 Mills St., Astoria, N. Y.
 Lees-Bradner Co., Cleveland, O.
 Meisselbach-Catucci Mfg. Co., 27 Congress St., Newark, N. J.
 Newark Gear Cutting Mch. Co., Newark, N. J.
 Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
 Reynolds Pattern & Mch. Co., Massillon, O.

Gears, Cut

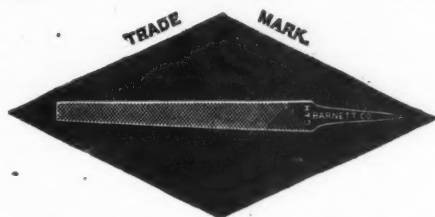
Acme Gear Works, Inc., 53 Mills St., Astoria, N. Y.
 Adams Co., Dubuque, Iowa.
 Albaugh-Dover Co., 2100 Marshall Blvd., Chicago, Ill.
 Albro-Clem Elevator Co., 701 Glenwood Ave., Philadelphia, Pa.
 Bilgram Mch. Works, 1231 Spring Garden St., Philadelphia, Pa.
 Boston Gear Works, Norfolk Downs, Mass.
 Braun Gear Works, 1321 Gates Ave., Brooklyn, N. Y.
 Brown Co., A. & F., 79 Barclay St., New York.
 Brown & Sharpe Mfg. Co., Providence, R. I.
 Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago, Ill.
 Cincinnati Gear Co., Cincinnati, O.
 Crofoot Gear Works, Inc., Cambridge A Branch, Boston, Mass.
 Cullman Wheel Co., 1339 Altgeld St., Chicago, Ill.
 Davis, Rodney, Philadelphia, Pa.
 Earle Gear & Mch. Co., 4705 Stenton Ave., Philadelphia, Pa.
 Fawcett Machine Co., Pittsburgh, Pa.
 Fellows Gear Shaper Co., Springfield, Vt.
 Flather Mfg. Co., E. J., Nashua, N. H.
 Foote Bros. Gear & Mch. Co., 210 N. Carpenter St., Chicago, Ill.

BLACK DIAMOND FILE WORKS

ESTABLISHED 1863

INCORPORATED 1895

Twelve Medals of
Award at
INTERNATIONAL
Expositions



Special Grand Prize
GOLD MEDAL
Atlanta, 1895

Copy of Catalogue will be sent free to any interested File User upon application

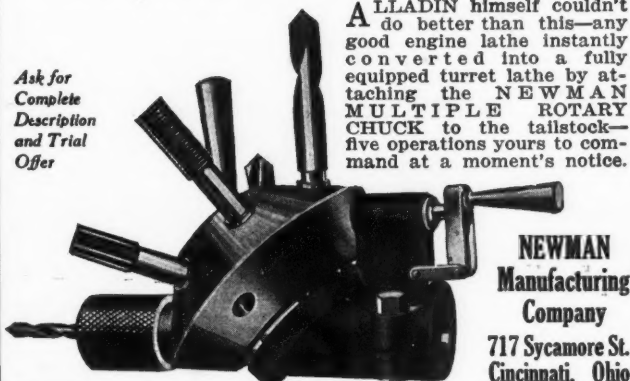
G. & H. BARNETT COMPANY

Philadelphia, Pa.

Owned and Operated by Nicholson File Company

A New Machine in 15 Seconds

Ask for
Complete
Description
and Trial
Offer



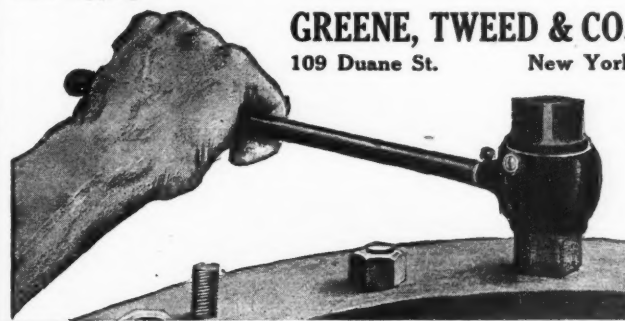
NEWMAN
Manufacturing
Company
717 Sycamore St.
Cincinnati, Ohio

ALLADIN himself couldn't do better than this—any good engine lathe instantly converted into a fully equipped turret lathe by attaching the **NEWMAN MULTIPLE ROTARY CHUCK** to the tailstock—five operations yours to command at a moment's notice.

If you consider the clumsy operations of the old-fashioned open end wrenches you will be sure to use the

FAVORITE REVERSIBLE RATCHET WRENCH

which works on a quick ratchet. Socket form of head prevents slipping.



GREENE, TWEED & CO.
109 Duane St. New York

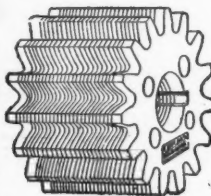
"MILFORD" HACK SAW BLADES



Sample sent on request
The HENRY G. THOMPSON & SON CO., New Haven, Conn.

"CHICAGO RAWHIDE" PINIONS

Standard of the World
We Originated the Rawhide Pinion
GEARS AND BLANKS
SPUR, BEVEL OR MITRE
Made promptly to any specifications
The Chicago Rawhide Mfg. Co.
1301 Elston Ave. Chicago, Ill.



SHIMS
to fit all milling
machine arbors

Saving 38 1/2 cents on each shim is not the only advantage of *buying* over making. "Practice makes perfect"—and we have had the practice in shim making.

STOCK SIZES—1/2, 5/8, 3/4, 7/8 and 1 inch; 1 1/8, 1 1/4, 1 3/8, 1 1/2, 1 5/8, 1 3/4, 1 7/8, 2, 2 1/2 and 3 inches inside diameter; .003, .005, .015, .025 inch thick. All accurately punched from cold-rolled steel, with or without standard keyways. .002 to 2.000 thicknesses made to order.

FREE SAMPLES.

DETROIT STAMPING CO.

Corner Fort and 24th Streets, Detroit, Mich.

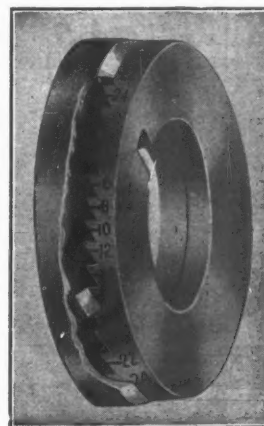
"WEAR-EVER" SPACER

The Wear-Ever Adjustable Spacing Collar saves time on milling machine operations. It is adjusted by means of 12 steps of .002" each—a total of .024" being obtained. The collar is thin and can be used in close quarters. There are no threads to strip—when adjustment is made the "Wear-Ever" is as solid as two plain disks.

Write for details.

Scully-Jones & Co.

647 Railway Exchange Bldg.
CHICAGO, U. S. A.



General Electric Co., Schenectady, N. Y.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Inc., Boston, Mass.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Hindley Gear Co., Philadelphia, Pa.
Horsburgh & Scott Co., Cleveland, O.
Lees-Bradner Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Meissel Press Mfg. Co., 948 Dorchester Ave., Boston, Mass.
Meisselbach-Catucci Mfg Co., 27 Congress St., Newark, N. J.
Newark Gear Cutting Mch. Co., Newark, N. J.
New Process Gear Corporation, Syracuse, N. Y.
Northern Engineering Works, Detroit, Mich.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Vine and 11th Sts., Philadelphia, Pa.
Poole Engineering & Mch. Co., Baltimore, Md.
Simonds Mfg. Co., Pittsburgh, Pa.
Stahl Gear & Mch. Co., Cleveland, O.
T. C. M. Mfg. Co., Harrison, N. J.
Van Dorn & Dutton Co., Cleveland, O.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Woburn Gear Works, Woburn, Mass.

Gears, Double Helical Cut
Earle Gear & Mch. Co., 4705 Stenton Ave., Philadelphia, Pa.
Fawcett Mch. Co., Pittsburgh, Pa.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.

Gears, Fabric, Rawhide, Bakelite, Etc.
Boston Gear Works, Norfolk Downs, Mass.
Brown Co., A. & F., 79 Barclay St., New York.
Chicago Rawhide Mfg. Co., 1301 Elston Ave., Chicago, Ill.
Cresson-Morris Co., Philadelphia, Pa.
Crofoot Gear Works, Inc., Cambridge A Branch, Boston, Mass.
Earle Gear & Mch. Co., 4705 Stenton Ave., Philadelphia, Pa.
Fawcett Mch. Co., Pittsburgh, Pa.
Foote Bros. Gear & Mch. Co., 210 N. Carpenter St., Chicago, Ill.

General Electric Co., Schenectady, N. Y.
Grant Gear Works, Inc., Boston, Mass.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., Cleveland, O.
Meissel Press Mfg. Co., 948 Dorchester Ave., Boston, Mass.
New Process Gear Corporation, Syracuse, N. Y.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Vine and 11th Sts., Philadelphia, Pa.
Stahl Gear & Mch. Co., Cleveland, O.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Molded
Brown Co., A. & F., 79 Barclay St., New York.
Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago, Ill.
Cresson-Morris Co., Philadelphia, Pa.
Crofoot Gear Works, Inc., Cambridge A Branch, Boston, Mass.
Franklin Mfg. Co., 738 Gifford St., Syracuse, N. Y.
Horsburgh & Scott Co., Cleveland, O.
Link-Belt Company, Chicago, Ill.
Philadelphia Gear Works, Vine and 11th Sts., Philadelphia, Pa.
Poole Engineering & Mch. Co., Baltimore, Md.
Stahl Gear & Mch. Co., Cleveland, O.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Worm
Albaugh-Dover Co., 2100 Marshall Blvd., Chicago, Ill.
Albro-Clem Elevator Co., 701 Glenwood Ave., Philadelphia, Pa.
Baugh Mch. Tool Co., 200 Wason Ave., Springfield, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Brown Co., A. & F., 79 Barclay St., New York.
Cincinnati Gear Co., Cincinnati, O.
Crofoot Gear Works, Inc., Cambridge A Branch, Boston, Mass.
Earle Gear & Mch. Co., 4705 Stenton Ave., Philadelphia, Pa.
Fawcett Mch. Co., Pittsburgh, Pa.
Foote Bros. Gear & Mch. Co., 210 N. Carpenter St., Chicago, Ill.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Hindley Gear Co., Philadelphia, Pa.
Horsburgh & Scott Co., Cleveland, O.
Link-Belt Company, Chicago, Ill.
Meissel Press Mfg. Co., 948 Dorchester Ave., Boston, Mass.
Newark Gear Cutting Mch. Co., Newark, N. J.
Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Vine and 11th Sts., Philadelphia, Pa.
Poole Engineering & Mch. Co., Baltimore, Md.
Van Dorn & Dutton Co., Cleveland, O.
Woburn Gear Works, Woburn, Mass.

Gear Testing Machinery
Adams Co., Dubuque, Iowa.
Gisholt Mch. Co., Madison, Wis.
Gleason Works, Rochester, N. Y.
Morse Twist Drill & Machine Co., New Bedford, Mass.

Gear Tooth Rounders
Ingle Machine Co., Rochester, N. Y.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Walker, Chas. H., Detroit, Mich.

Generators, Electric
Eck Dynamo & Motor Co., Belleville, N. J.
General Electric Co., Schenectady, N. Y.
Reliance Elec. & Eng. Co., 1056 Ivanhoe Road, Cleveland, O.
Sprague Electric Works, 527 W. 34th St., New York.
Triumph Electric Co., Cincinnati, O.

Generators, Gas
American Gas Furnace Co., 24 John St., New York.

Gibs and Keys for Connecting Rods
Moltrup Steel Products Co., Beaver Falls, Pa.

Goggles, Safety
Harley & Co., F. A., 10 S. Wabash Ave., Chicago, Ill.
Willson & Co., Inc., T. A., 3rd and Washington Sts., Reading, Pa.

Grinding Machines, Bench
Athol Mch. Co., Athol, Mass.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Builders Iron Foundry, Providence, R. I.
C & O Electric & Mfg. Co., Garwood, N. J.
Cincinnati Elec. Tool Co., Cincinnati, O.
Diamond Mch. Co., Providence, R. I.
Forbes & Myers, 178 Union St., Worcester, Mass.
Goodell-Pratt Co., Greenfield, Mass.

Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago, Ill.
Hissey-Wolf Mch. Co., Cincinnati, O.
New Britain Mch. Co., New Britain, Conn.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe & Grinder Co., Brighton, Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Standard Electric Tool Co., Cincinnati, O.
Wells & Son Co., F. E., Greenfield, Mass.

Grinding Machines, Center
Cincinnati Elec. Tool Co., Cincinnati, O.
Diamond Mch. Co., Providence, R. I.
Standard Elec. Tool Co., Cincinnati, O.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.

Grinding Machines, Chucking
Bryant Chucking Grinder Co., Springfield, Vt.
Grinding Machines, Cutter
Becker Milling Mch. Co., Hyde Park, Mass.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mch. Co., Oakley, Cincinnati, O.
Garvin Mch. Co., Spring and Varick Sts., New York.
Gould & Eberhardt, Newark, N. J.
Grand Rapids Grinding Mch. Co., Grand Rapids, Mich.
Greenfield Mch. Co., Greenfield, Mass.
Harris Engineering Co., H. E., Bridgeport, Conn.
Ingersoll Milling Mch. Co., Rockford, Ill.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Norton Grinding Co., Worcester, Mass.
Nutter & Barnes Co., Hinsdale, N. H.
Oesterlein Mch. Co., Cincinnati, O.
Pratt & Whitney Co., Hartford, Conn.
Simmons Mch. Co., 1001 Singer Bldg., New York.
Union Twist Drill Co., Athol, Mass.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.

Waltham Mch. Works, Waltham, Mass.
Wells & Son Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., 2180 Monroe Ave., N. W., Grand Rapids, Mich.

Grinding Machines, Cylindrical, Plain
Brown & Sharpe Mfg. Co., Providence, R. I.
Fitchburg Grinding Mch. Co., Fitchburg, Mass.
Greenfield Mch. Co., Greenfield, Mass.
Landis Tool Co., Waynesboro, Pa.
McDonough Mfg. Co., Eau Claire, Wis.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Norton Grinding Co., Worcester, Mass.
Ott Grinder Co., Indianapolis, Ind.
Pratt & Whitney Co., Hartford, Conn.
Thompson Grinder Co., Springfield, O.

Grinding Machines, Disc
Bealy & Co., Chas. H., 120-B N. Clinton St., Chicago, Ill.
Bickford Mch. Co., Greenfield, Mass.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Diamond Mch. Co., Providence, R. I.
Gardner Mch. Co., Weymouth, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Mch. Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.
Sellew Mch. Tool Co., Pawtucket, R. I.

Grinding Machines, Drill
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Grand Rapids Grinding Mch. Co., Grand Rapids, Mich.
Heald Machine Co., 20 New Bond St., Worcester, Mass.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Sterling Grinding Wheel Co., Tiffin, O.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.
Wilmarth & Morman Co., 2180 Monroe Ave., N. W., Grand Rapids, Mich.

Grinding Machines, Portable Electric
Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill.
Cincinnati Elec. Tool Co., Cincinnati, O.
Clark Elec. Co., Inc., Jas. Jr., Louisville, Ky.
Diamond Mch. Co., Providence, R. I.
Dillon Electric Co., Canton, O.
Forbes & Myers, 178 Union St., Worcester, Mass.
General Electric Co., Schenectady, N. Y.
Hissey-Wolf Mch. Co., Cincinnati, O.
Independent Pneumatic Tool Co., Chicago, Ill.
Neil & Smith Elec. Tool Co., Cincinnati, O.
Slocum, Avram & Slocum Laboratories, Inc., 531 W. 21st St., New York.
Standard Electric Tool Co., Cincinnati, O.
Stow Mfg. Co., Binghamton, N. Y.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.
Van Dorn Electric Tool Co., Cleveland, O.
Wisconsin Elec. Co., Racine, Wis.

Grinding Machines, Gage
Steel Products Engineering Co., Springfield, O.

Grinding Machines, Internal
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mch. Co., Oakley, Cincinnati, O.
Garvin Mch. Co., Spring and Varick Sts., New York.
Gould & Eberhardt, Newark, N. J.
Grand Rapids Grinding Mch. Co., Grand Rapids, Mich.
Greenfield Mch. Co., Greenfield, Mass.
Harris Engineering Co., H. E., Bridgeport, Conn.
Ingersoll Milling Mch. Co., Rockford, Ill.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Norton Grinding Co., Worcester, Mass.
Nutter & Barnes Co., Hinsdale, N. H.
Oesterlein Mch. Co., Cincinnati, O.
Pratt & Whitney Co., Hartford, Conn.
Simmons Mch. Co., 1001 Singer Bldg., New York.
Union Twist Drill Co., Athol, Mass.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.

Waltham Mch. Works, Waltham, Mass.
Wells & Son Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., 2180 Monroe Ave., N. W., Grand Rapids, Mich.

Grinding Machines, Chucking
Bryant Chucking Grinder Co., Springfield, Vt.
Grinding Machines, Cutter
Becker Milling Mch. Co., Hyde Park, Mass.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mch. Co., Oakley, Cincinnati, O.
Garvin Mch. Co., Spring and Varick Sts., New York.
Gould & Eberhardt, Newark, N. J.
Grand Rapids Grinding Mch. Co., Grand Rapids, Mich.
Greenfield Mch. Co., Greenfield, Mass.
Harris Engineering Co., H. E., Bridgeport, Conn.
Ingersoll Milling Mch. Co., Rockford, Ill.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Norton Grinding Co., Worcester, Mass.
Nutter & Barnes Co., Hinsdale, N. H.
Oesterlein Mch. Co., Cincinnati, O.
Pratt & Whitney Co., Hartford, Conn.
Simmons Mch. Co., 1001 Singer Bldg., New York.
Union Twist Drill Co., Athol, Mass.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.

Waltham Mch. Works, Waltham, Mass.
Wells & Son Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., 2180 Monroe Ave., N. W., Grand Rapids, Mich.

Grinding Machines, Cylindrical, Plain
Brown & Sharpe Mfg. Co., Providence, R. I.
Fitchburg Grinding Mch. Co., Fitchburg, Mass.
Greenfield Mch. Co., Greenfield, Mass.
Landis Tool Co., Waynesboro, Pa.
McDonough Mfg. Co., Eau Claire, Wis.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Norton Grinding Co., Worcester, Mass.
Ott Grinder Co., Indianapolis, Ind.
Pratt & Whitney Co., Hartford, Conn.
Thompson Grinder Co., Springfield, O.

Grinding Machines, Disc
Bealy & Co., Chas. H., 120-B N. Clinton St., Chicago, Ill.
Bickford Mch. Co., Greenfield, Mass.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Diamond Mch. Co., Providence, R. I.
Gardner Mch. Co., Weymouth, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Mch. Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.
Sellew Mch. Tool Co., Pawtucket, R. I.

Grinding Machines, Drill
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Grand Rapids Grinding Mch. Co., Grand Rapids, Mich.
Heald Machine Co., 20 New Bond St., Worcester, Mass.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Sterling Grinding Wheel Co., Tiffin, O.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.
Wilmarth & Morman Co., 2180 Monroe Ave., N. W., Grand Rapids, Mich.

Grinding Machines, Portable Electric
Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill.
Cincinnati Elec. Tool Co., Cincinnati, O.
Clark Elec. Co., Inc., Jas. Jr., Louisville, Ky.
Diamond Mch. Co., Providence, R. I.
Dillon Electric Co., Canton, O.
Forbes & Myers, 178 Union St., Worcester, Mass.
General Electric Co., Schenectady, N. Y.
Hissey-Wolf Mch. Co., Cincinnati, O.
Independent Pneumatic Tool Co., Chicago, Ill.
Neil & Smith Elec. Tool Co., Cincinnati, O.
Slocum, Avram & Slocum Laboratories, Inc., 531 W. 21st St., New York.
Standard Electric Tool Co., Cincinnati, O.
Stow Mfg. Co., Binghamton, N. Y.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.
Van Dorn Electric Tool Co., Cleveland, O.
Wisconsin Elec. Co., Racine, Wis.

Grinding Machines, Gage
Steel Products Engineering Co., Springfield, O.

Grinding Machines, Internal
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mch. Co., Oakley, Cincinnati, O.
Garvin Mch. Co., Spring and Varick Sts., New York.
Gould & Eberhardt, Newark, N. J.
Grand Rapids Grinding Mch. Co., Grand Rapids, Mich.
Greenfield Mch. Co., Greenfield, Mass.
Harris Engineering Co., H. E., Bridgeport, Conn.
Ingersoll Milling Mch. Co., Rockford, Ill.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Norton Grinding Co., Worcester, Mass.
Nutter & Barnes Co., Hinsdale, N. H.
Oesterlein Mch. Co., Cincinnati, O.
Pratt & Whitney Co., Hartford, Conn.
Simmons Mch. Co., 1001 Singer Bldg., New York.
Union Twist Drill Co., Athol, Mass.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.

Waltham Mch. Works, Waltham, Mass.
Wells & Son Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., 2180 Monroe Ave., N. W., Grand Rapids, Mich.

Grinding Machines, Cylindrical, Plain
Brown & Sharpe Mfg. Co., Providence, R. I.
Fitchburg Grinding Mch. Co., Fitchburg, Mass.
Greenfield Mch. Co., Greenfield, Mass.
Landis Tool Co., Waynesboro, Pa.
McDonough Mfg. Co., Eau Claire, Wis.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Norton Grinding Co., Worcester, Mass.
Ott Grinder Co., Indianapolis, Ind.
Pratt & Whitney Co., Hartford, Conn.
Thompson Grinder Co., Springfield, O.

Grinding Machines, Disc
Bealy & Co., Chas. H., 120-B N. Clinton St., Chicago, Ill.
Bickford Mch. Co., Greenfield, Mass.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Diamond Mch. Co., Providence, R. I.
Gardner Mch. Co., Weymouth, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Mch. Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.
Sellew Mch. Tool Co., Pawtucket, R. I.

Grinding Machines, Drill
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Grand Rapids Grinding Mch. Co., Grand Rapids, Mich.
Heald Machine Co., 20 New Bond St., Worcester, Mass.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Sterling Grinding Wheel Co., Tiffin, O.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.
Wilmarth & Morman Co., 2180 Monroe Ave., N. W., Grand Rapids, Mich.

Grinding Machines, Portable Electric
Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill.
Cincinnati Elec. Tool Co., Cincinnati, O.
Clark Elec. Co., Inc., Jas. Jr., Louisville, Ky.
Diamond Mch. Co., Providence, R. I.
Dillon Electric Co., Canton, O.
Forbes & Myers, 178 Union St., Worcester, Mass.
General Electric Co., Schenectady, N. Y.
Hissey-Wolf Mch. Co., Cincinnati, O.
Independent Pneumatic Tool Co., Chicago, Ill.
Neil & Smith Elec. Tool Co., Cincinnati, O.
Slocum, Avram & Slocum Laboratories, Inc., 531 W. 21st St., New York.
Standard Electric Tool Co., Cincinnati, O.
Stow Mfg. Co., Binghamton, N. Y.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.
Van Dorn Electric Tool Co., Cleveland, O.
Wisconsin Elec. Co., Racine, Wis.

Grinding Machines, Gage
Steel Products Engineering Co., Springfield, O.

Grinding Machines, Internal
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mch. Co., Oakley, Cincinnati, O.
Garvin Mch. Co., Spring and Varick Sts., New York.
Gould & Eberhardt, Newark, N. J.
Grand Rapids Grinding Mch. Co., Grand Rapids, Mich.
Greenfield Mch. Co., Greenfield, Mass.
Harris Engineering Co., H. E., Bridgeport, Conn.
Ingersoll Milling Mch. Co., Rockford, Ill.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Norton Grinding Co., Worcester, Mass.
Nutter & Barnes Co., Hinsdale, N. H.
Oesterlein Mch. Co., Cincinnati, O.
Pratt & Whitney Co., Hartford, Conn.
Simmons Mch. Co., 1001 Singer Bldg., New York.
Union Twist Drill Co., Athol, Mass.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.

Waltham Mch. Works, Waltham, Mass.
Wells & Son Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., 2180 Monroe Ave., N. W., Grand Rapids, Mich.

Grinding Machines, Cylindrical, Plain
Brown & Sharpe Mfg. Co., Providence, R. I.
Fitchburg Grinding Mch. Co., Fitchburg, Mass.
Greenfield Mch. Co., Greenfield, Mass.
Landis Tool Co., Waynesboro, Pa.
McDonough Mfg. Co., Eau Claire, Wis.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Norton Grinding Co., Worcester, Mass.
Ott Grinder Co., Indianapolis, Ind.
Pratt & Whitney Co., Hartford, Conn.
Thompson Grinder Co., Springfield, O.

Grinding Machines, Disc
Bealy & Co., Chas. H., 120-B N. Clinton St., Chicago, Ill.
Bickford Mch. Co., Greenfield, Mass.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Diamond Mch. Co., Providence, R. I.
Gardner Mch. Co., Weymouth, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Mch. Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.
Sellew Mch. Tool Co., Pawtucket, R. I.

Grinding Machines, Drill
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Grand Rapids Grinding Mch. Co., Grand Rapids, Mich.
Heald Machine Co., 20 New Bond St., Worcester, Mass.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Sterling Grinding Wheel Co., Tiffin, O.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.
Wilmarth & Morman Co., 2180 Monroe Ave., N. W., Grand Rapids, Mich.

Grinding Machines, Portable Electric
Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill.
Cincinnati Elec. Tool Co., Cincinnati, O.
Clark Elec. Co., Inc., Jas. Jr., Louisville, Ky.
Diamond Mch. Co., Providence, R. I.
Dillon Electric Co., Canton, O.
Forbes & Myers, 178 Union St., Worcester, Mass.
General Electric Co., Schenectady, N. Y.
Hissey-Wolf Mch. Co., Cincinnati, O.
Independent Pneumatic Tool Co., Chicago, Ill.
Neil & Smith Elec. Tool Co., Cincinnati, O.
Slocum, Avram & Slocum Laboratories, Inc., 531 W. 21st St., New York.
Standard Electric Tool Co., Cincinnati, O.
Stow Mfg. Co., Binghamton, N. Y.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.
Van Dorn Electric Tool Co., Cleveland, O.
Wisconsin Elec. Co., Racine, Wis.

Grinding Machines, Gage
Steel Products Engineering Co., Springfield, O.

Grinding Machines, Internal
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mch. Co., Oakley, Cincinnati, O.
Garvin Mch. Co., Spring and Varick Sts., New York.
Gould & Eberhardt, Newark, N. J.
Grand Rapids Grinding Mch. Co., Grand Rapids, Mich.
Greenfield Mch. Co., Greenfield, Mass.
Harris Engineering Co., H. E., Bridgeport, Conn.
Ingersoll Milling Mch. Co., Rockford, Ill.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Norton Grinding Co., Worcester, Mass.
Nutter & Barnes Co., Hinsdale, N. H.
Oesterlein Mch. Co., Cincinnati, O.
Pratt & Whitney Co., Hartford, Conn.
Simmons Mch. Co., 1001 Singer Bldg., New York.
Union Twist Drill Co., Athol, Mass.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.

Waltham Mch. Works, Waltham, Mass.
Wells & Son Co., F. E., Greenfield, Mass.
Wilmarth & Morman Co., 2180 Monroe Ave., N. W., Grand Rapids, Mich.

Grinding Machines, Cylindrical, Plain
Brown & Sharpe Mfg. Co., Providence, R. I.
Fitchburg Grinding Mch. Co., Fitchburg, Mass.
Greenfield Mch. Co., Greenfield, Mass.
Landis Tool Co., Waynesboro, Pa.
McDonough Mfg. Co., Eau Claire, Wis.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Norton Grinding Co., Worcester, Mass.
Ott Grinder Co., Indianapolis, Ind.
Pratt & Whitney Co., Hartford, Conn.
Thompson Grinder Co., Springfield, O.

Grinding Machines, Disc
Bealy & Co., Chas. H., 120-B N. Clinton St., Chicago, Ill.
Bickford Mch. Co., Greenfield, Mass.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Diamond Mch. Co., Providence, R. I.
Gardner Mch. Co., Weymouth, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Mch. Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.
Sellew Mch. Tool Co., Pawtucket, R. I.

Grinding Machines, Knife
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Diamond Mch. Co., Providence, R. I.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Safety Emery Wheel Co., Springfield, O.

Grinding Machines, Motor-Driven, Non-Portable
Dillon Electric Co., Canton, O.
Ransom Mfg. Co., Oshkosh, Wis.

Grinding Machines, Multiple Spindle
Bryant Chucking Grinder Co., Springfield, Vt.

Grinding Machines, Pipe Threading Die
Bignall & Keeler Mch. Works, Edwardsville, Ill.
Landis Mch. Co., Inc., Waynesboro, Pa.
National Mch. Co., Tiffin, O.

Grinding Machines, Piston Ring
Heald Machine Co., 20 New Bond St., Worcester, Mass.
Pedrick Tool & Mch. Co., 3639 N. Lawrence St., Philadelphia, Pa.
Walker Co., O. S., Worcester, Mass.

Grinding Machines, Radial, Ball Race, Etc.
Rivett Lathe & Grinding Co., Brighton, Boston, Mass.
Van Norman Machine Tool Co., Waltham Ave., Springfield, Mass.

Grinding Machines, Rotary Surface
Heald Machine Co., 20 New Bond St., Worcester, Mass.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Persons-Arter Mch. Co., Worcester, Mass.

Grinding Machines, Surface
Blake & Johnson Co., Waterbury, Conn.
Blanchard Machine Co., 64 State St., Cambridge, Mass.
Boston Scale & Machine Co., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Machine Co., Providence, R. I.
Fraser Co., Warren F., Boston, Mass.
Garvin Mch. Co., Spring and Varick Sts., New York.
Heald Machine Co., 20 New Bond St., Worcester, Mass.

Middlesex Mch. Works, Middletown, Conn.
New Jersey Mch. Exchange, Newark, N. J.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Norton Grinding Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.
Walker Co., O. S., Worcester, Mass.
Walls Tool Co., T. P., 75 Walker St., New York.
Wilmarth & Morman Co., 2180 Monroe Ave., N. W., Grand Rapids, Mich.

Grinding Machines, Tool and Cutter
Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
Baird Mch. Co., Bridgeport, Conn.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Blake & Johnson Co., Waterbury, Conn.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Elec. Tool Co., Cincinnati, O.
Cincinnati Milling Mch. Co., Oakley, Cincinnati, O.
Diamond Mch. Co., Providence, R. I.
Factory & Mill Supply Co., Boston, Mass.
Forbes & Myers, 178 Union St., Worcester, Mass.
Gisholt Mch. Co., Madison, Wis.
Grand Rapids Grinding Mch. Co., Grand Rapids, Mich.
Greenfield Machine Co., Greenfield, Mass.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
McDonough Mfg. Co., Eau Claire, Wis.
Meisselbach-Catucci Mfg. Co., 27 Congress St., Newark, N. J.

Modern Tool Co., 2nd and State Sts., Erie, Pa.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Newark Gear Cutting Mch. Co., Newark, N. J.
Norton Grinding Co., Worcester, Mass.
Nutter & Barnes Co., Hinsdale, N. H.
Oesterlein Mch. Co., Cincinnati, O.
Ott Grinder Co., Indianapolis, Ind.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Simmons Mch. Co., 1001 Singer Bldg., New York.
Standard Tool Co., Cleveland, O.
Taylor & Fenn Co., Hartford, Conn.
United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.

Vitrified Wheel Co., Westfield, Mass.
Walker Co., O. S., Worcester, Mass.
Wells & Son Co., F. E., Greenfield, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wilmarth & Morman Co., 2180 Monroe Ave., N. W., Grand Rapids, Mich.
Wisconsin Elec. Co., Racine, Wis.

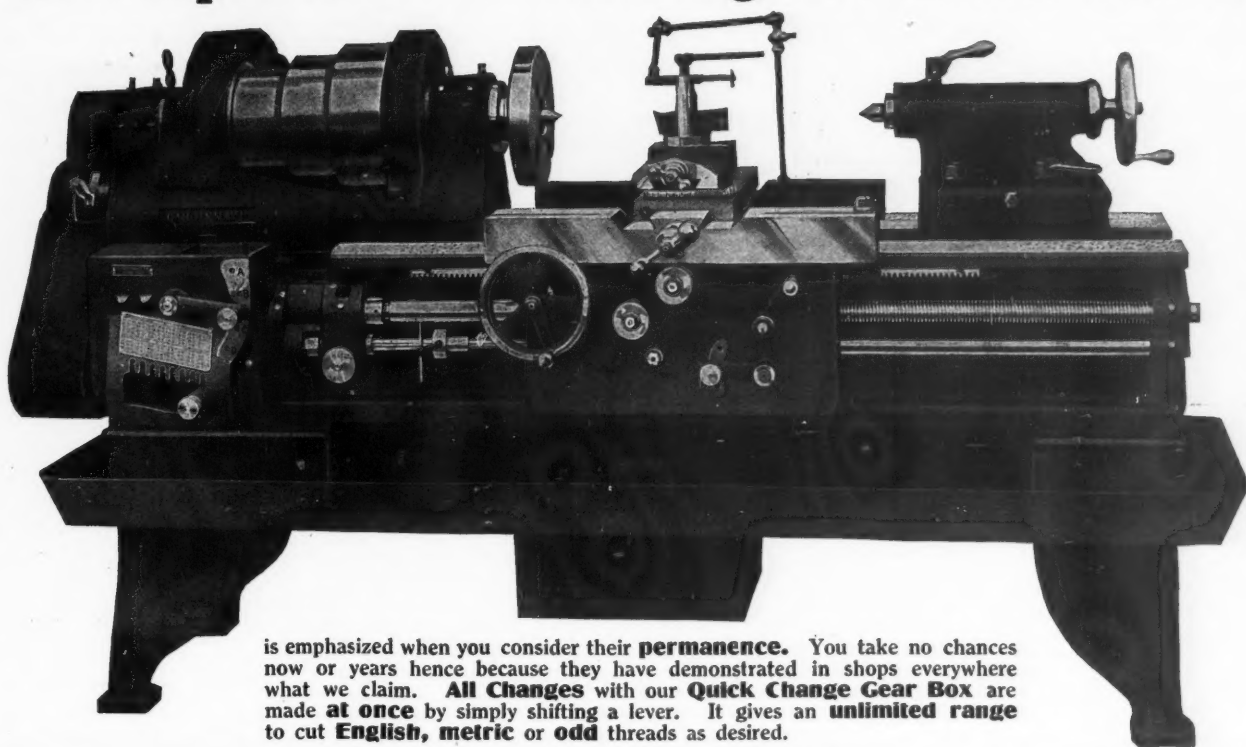
Grinding Machines, Universal, Lathe and Planer Tools
Gisholt Machine Co., Madison, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Grinding Wheels
Abrasive Co., Bridesburg, Philadelphia, Pa.
American Emery Wheel Works, Providence, R. I.
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Carborundum Co., Niagara Falls, N. Y.
Detroit Grinding Wheel Co., Detroit, Mich.
Norton Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Springfield Grinding Co., Chester, Mass.
Star Corundum Wheel Co., Detroit, Mich.
Sterling Grinding Wheel Co., Tiffin, O.
Vitrified Wheel Co., Westfield, Mass.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., 5 Adams St., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Erie Foundry Co., Erie, Pa.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., 111 Broadway, New York.
Williams, White & Co., Moline, Ill.

Hammers, Pneumatic
Erie Foundry Co., Erie, Pa.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York.
Nazel Engineering Works, 4043 N. 5th St., Philadelphia, Pa.

The Importance of Selecting Cincinnati Lathes



is emphasized when you consider their **permanence**. You take no chances now or years hence because they have demonstrated in shops everywhere what we claim. **All Changes** with our **Quick Change Gear Box** are made **at once** by simply shifting a lever. It gives an **unlimited range** to cut **English, metric or odd** threads as desired.

SEND FOR OUR LATEST LITERATURE

THE CINCINNATI LATHE & TOOL CO.

Cable Address (CINTILATHE)

OAKLEY, CINCINNATI, OHIO, U. S. A.

SHUSTER Wire Straightening and Cutting-Off Machines

Shuster Wire Straighteners are used by many of the largest steel companies in the country, the photograph showing one of a battery of four—a $\frac{3}{4}$ " capacity machine—straightening wire in the plant of the Carpenter Steel Company, Reading, Pa. The wire goes from the coil directly through the straightening arbor and is automatically cut into 12' lengths that are as straight as an arrow. Operation is continuous except when a new coil is inserted. Although this machine has been in service ten years, it shows practically no evidence of the strain its enormous production has entailed. The Shuster Wire Straightener is built for accuracy and lasting service. Let us send more details. Catalogue R.

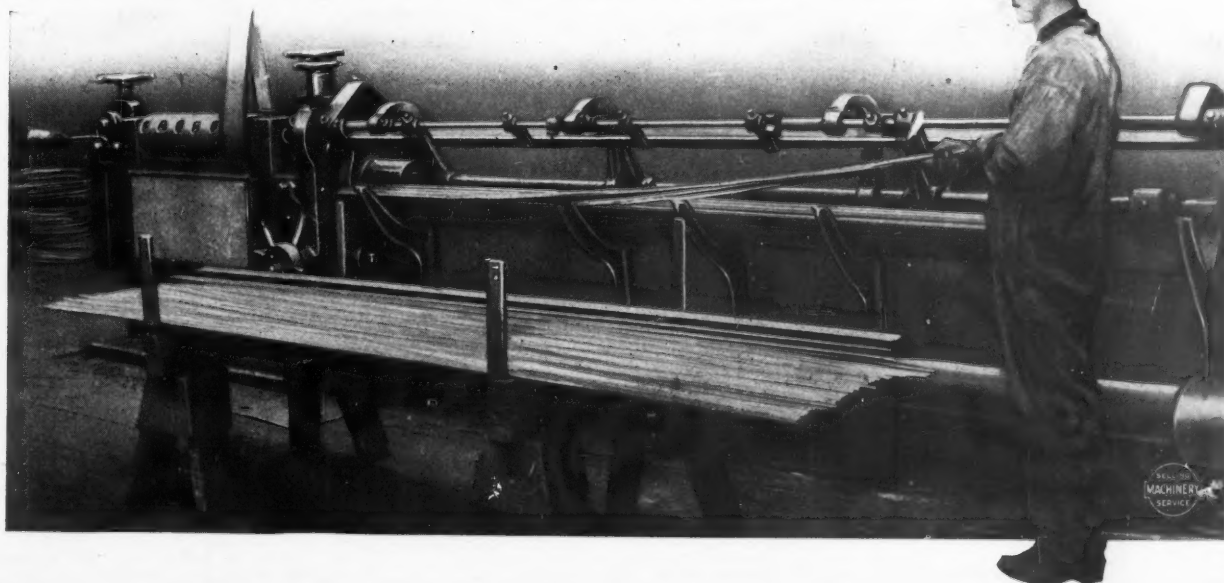
*Four in the
Carpenter Steel
Plant
at Reading*

THE F. B. SHUSTER CO., New Haven, Conn.

Formerly John Adt & Son

Est. 1866

Also makers of Riveting Machines, etc.



Hammers, Power

Beaudry & Co., Inc., Boston, Mass.
 Bradley & Son, Inc., C. C. Syracuse, N. Y.
 Buffalo Foundry & Mch. Co., 10 Winchester Ave., Buffalo, N. Y.
 Dismett & Eisenhardt, Inc., Philadelphia, Pa.
 Erie Foundry Co., Erie, Pa.
 Mayer Bros. Co., 131 Rock St., Mankato, Minn.
 Naze Engineering Works, 4043 N. 5th St., Philadelphia, Pa.
 West Tire Setter Co., Rochester, N. Y.
 Williams, White & Co., Moline, Ill.

Hammers, Steam

Buffalo Foundry & Mch. Co., 10 Winchester Ave., Buffalo, N. Y.
 Chambersburg Engineering Co., Chambersburg, Pa.
 Erie Foundry Co., Erie, Pa.
 Niles-Bement-Pond Co., 111 Broadway, New York.
 Sellers & Co., Inc., Wm., Philadelphia, Pa.

Handles, Machine

Cincinnati Ball Crank Co., Cincinnati, O.
 Cincinnati Screw Co., Cincinnati, O.

Hangers, Shaft

Brown & Sharpe Mfg. Co., Providence, R. I.
 Brown Co., A. & F., 79 Barclay St., New York.
 Cresson-Morris Co., Philadelphia, Pa.
 Fafnir Bearing Co., New Britain, Conn.
 Hess-Bright Mfg. Co., Front St. and Erie Ave., Philadelphia, Pa.
 Hyatt Roller Bearing Co., Newark, N. J.
 Link-Belt Company, Chicago, Ill.
 New Departure Mfg. Co., Bristol, Conn.
 Roversford Fdry. & Mch. Co., 54 N. 5th St., Philadelphia, Pa.
 Sellers & Co., Inc., Wm., Philadelphia, Pa.
 S. K. F. Ball Bearing Co., Hartford, Conn.
 Standard Pressed Steel Co., Philadelphia, Pa.
 Wood Sons Co., T. B., Chambersburg, Pa.

Hardness Testing Instruments

Shore Instrument & Mfg. Co., Inc., 557 W. 22nd St., New York

Heating and Ventilating Apparatus

Buffalo Forge Co., Buffalo, N. Y.

Hobbing Machines

See Gear Cutting Machines, Helical and Spur (Hob) and Gear Cutting Machines, Worms and Worm Wheels (Hob).

Hobs

Adams Co., Dubuque, Iowa.
 Barber-Colman Co., Rockford, Ill.
 Brown & Sharpe Mfg. Co., Providence, R. I.
 Goddard Tool Co., Chicago, Ill.
 Gould & Eberhardt, Newark, N. J.
 Illinois Tool Works, Chicago, Ill.
 Lees-Bradner Co., Cleveland, O.
 Meisselbach-Catucci Mfg. Co., 27 Congress St., Newark, N. J.
 Michigan Tool Co., Detroit, Mich.
 Union Twist Drill Co., Athol, Mass.

Holisting and Conveying Machinery

Caldwell & Son, Co., H. W., 17th St. and Western Ave., Chicago, Ill.
 Link-Belt Company, Chicago, Ill.
 Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.
 Wright Mfg. Co., Lisbon, O.
 Yale & Towne Mfg. Co., 9 E. 40th St., New York.

Holists, Air

Ingersoll-Rand Co., 11 Broadway, New York.
 Northern Engineering Works, Detroit, Mich.

Holists, Chain, Etc.

Box & Co., Alfred, Philadelphia, Pa.
 Ford Chain Block & Mfg. Co., Philadelphia, Pa.
 Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
 Mason & Co., Inc., Volney W., Providence, R. I.
 Wright Mfg. Co., Lisbon, O.
 Yale & Towne Mfg. Co., 9 E. 40th St., New York.

Holists, Electric

Box & Co., Alfred, Philadelphia, Pa.
 Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill.
 General Electric Co., Schenectady, N. Y.
 Link-Belt Company, Chicago, Ill.
 Northern Engineering Works, Detroit, Mich.
 Sprague Electric Works, 527 W. 34th St., New York.
 Thomas Elevator Co., 22 S. Hoyne Ave., Chicago, Ill.
 Toledo Bridge & Crane Co., Toledo, O.
 Yale & Towne Mfg. Co., 9 E. 40th St., New York.

Holists, Pneumatic

Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill.
 Curtis Pneumatic Mch. Co., 1568 Kienlen Ave., St. Louis, Mo.
 Ingersoll-Rand Co., 11 Broadway, New York.
 Northern Engineering Works, Detroit, Mich.

Holists, Portable

Brown Clutch Co., Sandusky, O.
 Canton Foundry & Machine Co., Canton, O.

Horses, Steel

Frasse & Co., Inc., Peter A., 417 Canal St. New York.

Hydraulic Machinery and Tools

Bethlehem Steel Co., South Bethlehem, Pa.
 Chambersburg Engineering Co., Chambersburg, Pa.
 Hydraulic Press Mfg. Co., 84 Lincoln Ave., Mt. Gilead, O.
 Metalwood Mfg. Co., Detroit, Mich.
 Watson-Stillman Co., 192 Fulton St., New York.
 Williams, White & Co., Moline, Ill.

Indicators, Speed

Brown & Sharpe Mfg. Co., Providence, R. I.
 Brown Instrument Co., Philadelphia, Pa.
 Goodell-Pratt Co., Greenfield, Mass.
 Greene, Tweed & Co., 109 Duane St., New York.
 Johnson & Miller, 42 Murray St., New York.
 Starratt Co., L. S., Athol, Mass.
 Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn.

Indicators, Test

Brown & Sharpe Mfg. Co., Providence, R. I.
 Brown Instrument Co., Philadelphia, Pa.
 Johnson & Miller, 42 Murray St., New York.
 Norton Grinding Co., Worcester, Mass.
 Slocum, Avram & Slocum Laboratories, Inc., 531 W. 21st St., New York.
 Starratt Co., L. S., Athol, Mass.

Injectors, Steam

Sellers & Co., Inc., Wm., Philadelphia, Pa.
 Walworth Mfg. Co., Boston, Mass.

Jacks, Hydraulic

Watson-Stillman Co., 192 Fulton St., New York.

Jacks, Planer

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.

Jigs and Fixtures

American Mch. & Foundry Co., 5520 2nd Ave., Brooklyn, N. Y.
 American Tool & Mfg. Co., Urbana, O.
 Automat Tool Works, 252 Greenwich St., New York.
 Becker Milling Mch. Co., Hyde Park, Mass.
 Columbus Die, Tool & Mch. Co., Columbus, O.
 Fox Gun Co., A. H., Philadelphia, Pa.
 Gardam & Son, Inc., Wm., 108 Park Place, New York.
 Gisholt Mch. Co., Madison, Wis.
 Goddard Tool Co., Chicago, Ill.
 Harris Engineering Co., H. E., Bridgeport, Conn.
 Krasberg Mfg. Co., 412 Orleans St., Chicago, Ill.
 Lansing Stamping & Tool Co., Lansing, Mich.
 Maute & Sons, J., Buffalo, N. Y.
 Mehl Mch. Tool & Die Co., Roselle, N. J.
 Michigan Tool Co., Detroit, Mich.
 Middlesex Machine Works, Middletown, Conn.
 Modern Tool, Die & Machine Co., Columbus, O.
 Moore-Eastwood Mfg. Co., Dayton, O.
 Nelson Tool Co., 783 E. 152nd St., New York.
 North Side Tool Works, Dayton, O.
 Off-Set Tool Co., Bridgeport, Conn.
 Ohmer Fare Register Co., Dayton, O.
 Reynolds Pattern & Mch. Co., Massillon, O.
 Slocum, Avram & Slocum Laboratories, Inc., 531 W. 21st St., New York.
 Solar Metal Products Co., Inc., Columbus, O.
 S. P. Mfg. Co., Cleveland, O.
 Steel Products Engineering Co., Springfield, O.
 Steiner Bros., Lima, O.
 Swedish Gage Co., Inc., 16 W. 61st St., New York.
 Taft-Peace Mfg. Co., Woonsocket, R. I.
 Taylor-Shantz Co., Rochester, N. Y.
 T. C. M. Mfg. Co., Harrison, N. J.
 Ulmer Co., J. C., Cleveland, O.
 Urbana Tool & Die Co., Urbana, O.
 Windau Tool Co., Cleveland, O.

Kettles, Soda

Brown & Sharpe Mfg. Co., Providence, R. I.
 Gray & Prior Mch. Co., 38 Suffolk St., Hartford, Conn.
 Niles-Bement-Pond Co., 111 Broadway, New York.

Keyseaters

Advance Tool Co., Cincinnati, O.
 Baker Bros., Toledo, O.
 Burr & Son, J. T., 429 Kent Ave., Brooklyn, N. Y.
 Davis Mch. Tool Co., Inc., Rochester, N. Y.
 Lapointe Mch. Tool Co., Hudson, Mass.
 Mitts & Merrill, 843 Water St., Saginaw, Mich.
 Morton Mfg. Co., Muskegon Heights, Mich.
 Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
 Niles-Bement-Pond Co., 111 Broadway, New York.

Keys, Machine

Moltrup Steel Products Co., Beaver Falls, Pa.
 Morton Mfg. Co., Muskegon Heights, Mich.
 Standard Gauge Steel Co., Beaver Falls, Pa.
 Whitney Mfg. Co., Hartford, Conn.
 Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

Knives, Machine

Coes Wrench Co., Worcester, Mass.
 Simonds Mfg. Co., Fitchburg, Mass.

Knurl Holders

Graham Mfg. Co., Providence, R. I.
 Pratt & Whitney Co., Hartford, Conn.

Knurling Tools

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
 Billings & Spencer Co., Hartford, Conn.
 Goodell-Pratt Co., Greenfield, Mass.
 Pratt & Whitney Co., Hartford, Conn.
 Wells & Son Co., F. E., Greenfield, Mass.
 Williams & Co., J. H., 61 Richard St., Brooklyn, N. Y.

Lamp Brackets, Guards, Etc.

McCrosky Reamer Co., Meadville, Pa.
 Newman Mfg. Co., Cincinnati, O.

Lamps, Electric

General Electric Co., Schenectady, N. Y.
 Westinghouse Lamp Co., 165 Broadway, New York.

Lapping Machines, Power

Builders Iron Foundry, Providence, R. I.

Lathe Attachments

American Tool Works Co., Cincinnati, O.
 Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
 Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
 Boye & Emmes Mch. Tool Co., Cincinnati, O.
 Bradford Mch. Tool Works, 151 Winton Road, Rochester, N. Y.
 Carroll-Jamieson Mch. Tool Co., 257 Davis St., Batavia, O.
 Champion Tool Works Co., 2422 Spring Grove Ave., Cincinnati, O.
 Chard Lathe Co., Newcastle, Ind.
 Cincinnati Iron & Steel Co., Cincinnati, O.
 Davis Machine Tool Co., Inc., Rochester, N. Y.
 Diamond Machine Co., Providence, R. I.
 Fitchburg Machine Works, Fitchburg, Mass.
 Flather & Co., Inc., Nashua, N. H.
 Garvin Mch. Co., Spring and Varick Sts., New York.
 Greaves-Klusman Tool Co., Cincinnati, O.
 Hendey Mch. Co., Torrington, Conn.
 LeBlond Mch. Tool Co., R. K., Cincinnati, O.
 Lodge & Shipley Mch. Tool Co., Cincinnati, O.
 Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.
 Monarch Mch. Tool Co., Sidney, O.
 Mueller Mch. Tool Co., Cincinnati, O.
 Newman Mfg. Co., Cincinnati, O.
 Niles-Bement-Pond Co., 111 Broadway, New York.
 Oliver Machinery Co., 7 Coldbrook St., Grand Rapids, Mich.
 Pratt & Whitney Co., Hartford, Conn.
 Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass.
 Rivett Lathe & Grinder Co., Brighton, Boston, Mass.
 Rockford Tool Co., Rockford, Ill.
 Sebastian Lathe Co., Cincinnati, O.
 Seneca Falls Mfg. Co., 330 Fall St., Seneca Falls, N. Y.
 Slocum, Avram & Slocum Laboratories, Inc., 531 W. 21st St., New York.
 Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.
 Vandyck Churchill Co., 149 Broadway, New York.
 Willard Machine Tool Co., Cincinnati, O.
 Wood & Safford Machine Works, Great Falls, Montana.

Lathe Dogs

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
 Billings & Spencer Co., Hartford, Conn.
 Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
 Ready Tool Co., Bridgeport, Conn.
 Underwood & Co., H. B., Philadelphia, Pa.
 Western Tool & Mfg. Co., Springfield, O.
 West Steel Casting Co., Cleveland, O.
 Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

Lathe, Planer and Shaper Tools

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
 Billings & Spencer Co., Hartford, Conn.
 Chard Lathe Co., Newcastle, Ind.
 Gisholt Machine Co., Madison, Wis.
 McCrosky Reamer Co., Meadville, Pa.
 O. K. Tool Holder Co., Shelton, Conn.
 Pratt & Whitney Co., Hartford, Conn.
 Ready Tool Co., Bridgeport, Conn.
 Sebastian Lathe Co., Cincinnati, O.
 Thompson & Son Co., Henry G., New Haven, Conn.
 West Haven Mfg. Co., New Haven, Conn.
 Western Tool & Mfg. Co., Springfield, O.
 Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

Lathes, Automatic

Fitchburg Automatic Mch. Works, Fitchburg, Mass.
 Gisholt Mch. Co., Madison, Wis.
 Jones & Lamson Mch. Co., Springfield, Vt.
 New Britain Mch. Co., New Britain, Conn.
 Potter & Johnston Mch. Co., Pawtucket, R. I.
 Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass.

Lathes, Automatic Screw Threading

Automatic Machine Co., Bridgeport, Conn.

Lathes, Axle and Shaft

Bridgeford Mch. Tool Works, 151 Winton Road, Rochester, N. Y.
 Fitchburg Machine Works, Fitchburg, Mass.
 Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.
 Niles-Bement-Pond Co., 111 Broadway, New York.
 Sellers & Co., Inc., Wm., Philadelphia, Pa.

Lathes, Bench

Ames Co., B. C., Waltham, Mass.
 Dalton Manufacturing Corporation, 1911 Park Ave., New York.
 Diamond Mch. Co., Providence, R. I.
 Elgin Tool Works, Elgin, Ill.
 Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago, Ill.
 Hjorth Lathe & Tool Co., Boston, Mass.
 Pratt & Whitney Co., Hartford, Conn.
 Rivett Lathe & Grinder Co., Brighton, Boston, Mass.
 Seneca Falls Mfg. Co., 330 Fall St., Seneca Falls, N. Y.
 Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
 Van Norman Mch. Tool Co., Springfield, O.
 Wade, Walter H., Boston, Mass.
 Waltham Mch. Works, Waltham, Mass.
 Wells & Son Co., F. E., Greenfield, Mass.

Lathes, Boring

Gisholt Mch. Co., Madison, Wis.
 Sellers & Co., Inc., Wm., Philadelphia, Pa.

Lathes, Brass Workers'

Acme Machine Tool Co., Cincinnati, O.
 Bardons & Oliver, Cleveland, O.
 Dreses Mch. Tool Co., Cincinnati, O.
 Garvin Mch. Co., Spring and Varick Sts., New York.
 Pierce Mch. Tool Co., 617 W. Jackson Blvd., Chicago, Ill.
 Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.
 Warner & Swasey Co., Cleveland, O.
 Wood Turret Mch. Co., Brazil, Ind.

Lathes, Car Wheel

Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.
 Niles-Bement-Pond Co., 111 Broadway, New York.
 Sellers & Co., Inc., Wm., Philadelphia, Pa.

Lathes, Crankshaft

American Tool Works Co., Cincinnati, O.
 LeBlond Mch. Tool Co., R. K., Cincinnati, O.
 Lodge & Shipley Mch. Tool Co., Cincinnati, O.
 Niles-Bement-Pond Co., 111 Broadway, New York.

Lathes, Engine

American Tool Works Co., Cincinnati, O.
 14" to 24", inclusive.
 Axelson Mch. Co., Los Angeles, Cal.
 16" and 18".
 Barnes Co., W. F. & John, Rockford, Ill.
 9" to 18", inclusive.
 Barnes Drill Co., Inc., Rockford, Ill.
 14-24" and 22-36" gap.
 Bosworth, W. H., Cleveland, O. 16".
 Boye & Emmes Mch. Tool Co., Cincinnati, O.
 18" to 48", inclusive.
 Bradford Mch. Tool Co., Cincinnati, O.
 14" to 42", inclusive.
 Bridgeford Mch. Tool Works, 151 Winton Road, Rochester, N. Y. 26" to 48", inclusive.
 Carroll-Jamieson Mch. Tool Co., 257 Davis St., Batavia, O. 13" and 14".
 Champion Tool Works Co., 2422 Spring Grove Ave., Cincinnati, O. 12" to 18", inclusive.
 Chard Lathe Co., Newcastle, Ind. 16" to 28", incl.
 Cincinnati Iron & Steel Co., Cincinnati, O. 14" to 24", inclusive.
 Cincinnati Lathe & Tool Co., Oakley, Cincinnati, O. 16" to 22", incl.
 Dalton Manufacturing Corporation, 1911 Park Ave., New York. 6" to 18" inclusive.
 Davis Mch. Tool Co., Inc., Rochester, N. Y. 12" to 42", inclusive.
 Earle Gear & Mch. Co., Philadelphia, Pa. 14" and 18".
 Flather & Co., Inc., Nashua, N. H. 13" to 28", incl.
 Gisholt Mch. Co., Madison, Wis. 16" and 25".
 Greaves-Klusman Tool Co., Cincinnati, O. 16" to 30".
 Hamilton Mch. Tool Co., Hamilton, O. 14" to 24".
 Hendey Mch. Co., Torrington, Conn. 12" to 24".
 Hill, Clark & Co., Inc., Boston, Mass. 18" to 30" inclusive.
 Himoff Mch. Co., 45 Mills St., Astoria, N. Y. 11" to 21", inclusive.
 Houston, Stanwood & Gamble Co., Cincinnati, O. 30" to 60", inclusive.
 LeBlond Mch. Tool Co., R. K., Cincinnati, O. 12" to 36".
 Lehmann Mch. Co., St. Louis, Mo. 16".
 Lodge & Shipley Mch. Tool Co., Cincinnati, O. 14" to 48", inclusive.
 Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York. 12" to 84", inclusive.
 Master Mch. Tool Co., 110 W. 40th St., New York 12".

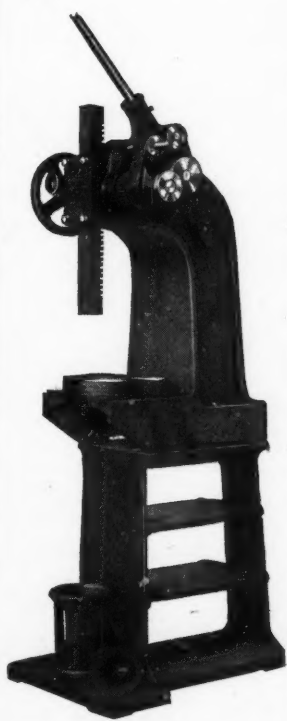


This photograph of a veteran toolmaker "Delta-filing" dies used for trimming large nuts, was taken at a Pittsburgh plant which makes screws ranging from $\frac{1}{4}$ " to 50" in length. It's a plant which turns out 2,500,000 nuts a week and a plant where Delta Files are used to the exclusion of all other makes, and have been for the past five or six years.

Delta Files get the call in the big shops because they meet big demands; and they meet big demands because they are made right.

For maximum file service and minimum file cost, specify "Delta."

**DELTA
FILE
WORKS
PHILADELPHIA**



No. 3 Press with
Pedestal

POWERFUL ACCURATE DURABLE

Atlas Presses are built in all sizes and types for driving mandrels, bending and straightening, broaching, embossing with dies, setting bushings, etc. In fact all work requiring pressure up to 25 tons and centering capacity up to 38 inches may be done quicker and easier on our *Compound Presses* than by any other method.

Let us send you our
catalog matter

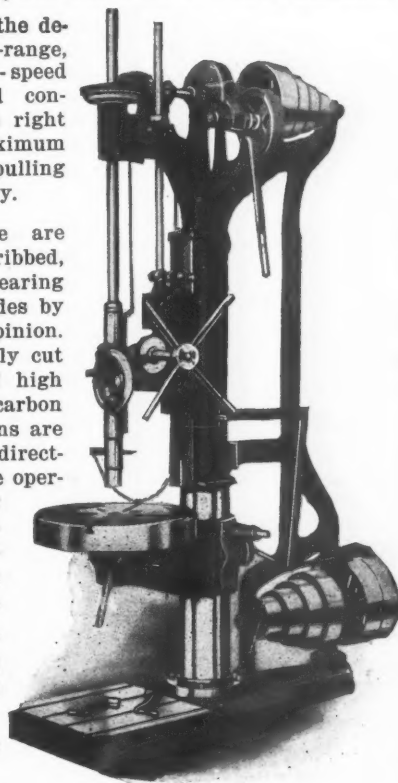
ATLAS PRESS COMPANY
323 No. Park St. Kalamazoo, Mich.

AURORA UPRIGHT DRILLS

Designed to meet the demand for wide-range, heavy-duty, high-speed machines, and constructed along the right lines to insure maximum case of operation, pulling power and accuracy.

Column and base are heavy and well ribbed, head has a long bearing on column and slides by means of rack and pinion. Gears are accurately cut from semi-steel of high manganese and carbon content; and pinions are of steel. Feeds are directly controlled by the operator, any one being automatically disengaged at any desired depth by an automatic stop.

Both stationary and sliding head types and various sizes.



Send for
Circulars

THE AURORA TOOL WORKS
AURORA INDIANA, U. S. A.

Monarch Mch. Tool Co., Sidney, O. 14" to 20", incl.
 Morris Mch. Tool Co., Cincinnati, O. 16" to 21" incl.
 Mueller Mch. Tool Co., Cincinnati, O. 18".
 National Lathe Co., Cincinnati, O. 17" and 18".
 Niles-Bement-Pond Co., 111 Broadway, New York.

26" to 160", inclusive.
 Oliver Mch. Co., 7 Coldbrook St., Grand Rapids, Mich. 16" to 26", inclusive.
 Porter-Cable Mch. Co., Syracuse, N. Y. 12".
 Pratt & Whitney Co., Hartford, Conn. 10" to 16", inclusive.

Rahn-Larmon Co., Cincinnati, O. 16" to 32" incl.
 Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass. 12" to 27", incl.
 Rockford Tool Co., Rockford, Ill. 15" and 16".

Seneca Falls Mfg. Co., 330 Fall St., Seneca Falls, N. Y. 9" to 16", inclusive.
 Sidney Tool Co., Sidney, O. 17" and 19".
 Simplex Mch. Tool Co., Hamilton, O. 16" to 32", incl.
 Smith Mfg. Co., Philip, Sidney, O. 13".

South Bend Lathe Works, South Bend, Ind. 13" to 24", inclusive.
 Springfield Mch. Tool Co., Springfield, O. 14" to 36", inclusive.
 Taylor Mch. Co., Cleveland, O. 20".

United States Lathe & Mch. Co., Cincinnati, O. 20" to 24", inclusive.
 Universal Mch. Co., Milwaukee, Wis. 12" to 24", inclusive.
 Walcott Lathe Co., Jackson, Mich. 14" to 28", incl.

Whitcomb-Blaisdell Mch. Tool Co., Worcester, Mass. 14" to 30", inclusive.
 Wickes Bros., Saginaw, Mich. 17" to 30" inclusive.
 Willard Mch. Tool Co., Cincinnati, O. 13".
 Worcester Lathe Co., Worcester, Mass. 11", 13" and 16".

Lathes, Extension, Bed and Gap
 Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
 Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
 Manning, Maxwell & Moore, Inc., 119 W. 40th St., N. Y.

Rahn-Larmon Co., Cincinnati, O.
 Sebastian Lathe Co., Cincinnati, O.
Lathes, Foot Power
 Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.

Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass.
 Seneca Falls Mfg. Co., 330 Fall St., Seneca Falls, N. Y.

Lathes, Patternmakers'
 Blount Co., J. G., Everett, Mass.
 Oliver Machinery Co., 7 Coldbrook St., Grand Rapids, Mich.

Wells & Son Co., F. E., Greenfield, Mass.
Lathes, Pulley
 Cincinnati Pulley Mch. Co., Cincinnati, O.

Lathes, Shell
 Thurlow Steel Works, Inc., Philadelphia, Pa.

Lathes, Speed
 Blount Co., J. G., Everett, Mass.
 Diamond Mch. Co., Providence, R. I.
 Himoff Mch. Co., 45 Mills St., Astoria, N. Y.

Oliver Machinery Co., 7 Coldbrook St., Grand Rapids, Mich.
 Seneca Falls Mfg. Co., 330 Fall St., Seneca Falls, N. Y.

Wells & Son Co., F. E., Greenfield, Mass.
Lathes, Turret
 See also Chucking Machines.

Acme Mch. Tool Co., Cincinnati, O.
 Bardons & Oliver, Cleveland, O.
 Brown & Sharpe Mfg. Co., Providence, R. I.
 Bullard Mch. Tool Co., Bridgeport, Conn.
 Davis Mch. Tool Co., Inc., Rochester, N. Y.

Dreses Mch. Tool Co., Cincinnati, O.
 Foster Mch. Co., Elkhart, Ind.
 Garvin Mch. Co., Spring and Varick Sts., New York.

Gisholt Mch. Co., Madison, Wis.
 Greaves-Klusman Tool Co., Cincinnati, O.
 Himoff Mch. Co., 45 Mills St., Astoria, N. Y.

International Mch. Tool Co., Indianapolis, Ind.
 Jones & Lamson Mch. Co., Springfield, Vt.
 LeBlond Mch. Tool Co., R. K., Cincinnati, O.

Lodge & Shipley Mch. Tool Co., Cincinnati, O.
 Morris Mch. Tool Co., Cincinnati, O.
 New Britain Mch. Co., New Britain, Conn.

Niles-Bement-Pond Co., 111 Broadway, New York.
 Oliver Machinery Co., 7 Coldbrook St., Grand Rapids, Mich.
 Pierce Mch. Tool Co., 617 W. Jackson Blvd., Chicago, Ill.

Pratt & Whitney Co., Hartford, Conn.
 Rahn-Larmon Co., Cincinnati, O.
 Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass.

Rivett Lathe & Grinder Co., Brighton, Boston, Mass.
 Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.
 Warner & Swasey Co., Cleveland, O.

Wells & Son Co., F. E., Greenfield, Mass.
 Wood Turret Mch. Co., Brazil, Ind.

Lathes, Wood Workers'
 Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
 Oliver Machinery Co., 7 Coldbrook St., Grand Rapids, Mich.

Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass.
 Seneca Falls Mfg. Co., 330 Fall St., Seneca Falls, N. Y.

Leather Belting, Round
 Schieren Co., Chas. A., 73 Ferry St., New York.

Levels
 Goodell-Pratt Co., Greenfield, Mass.
 Keuffel & Esser Co., Hoboken, N. J.
 Starrett Co., L. S., Athol, Mass.

Lockers, Metal
 Manufacturing Equipment & Eng. Co., Framingham, Mass.

Lubricators
 Bealy & Co., Chas. H., 120-B N. Clinton St., Chicago, Ill.
 Greene, Tweed & Co., 109 Duane St., New York.

Inter-State Mch. Products Co., Inc., Rochester, N. Y.
Machinery Dealers
 Bealy & Co., Chas. H., 120-B N. Clinton St., Chicago, Ill.

Brownell Mch. Co., Providence, R. I.
 Coats Mch. Tool Co., Inc., 30 Church St., New York.
 Davis Mch. Tool Co., W. F., 32 N. Clinton St., Chicago, Ill.

Earle Gear & Mch. Co., 4705 Stenton Ave., Philadelphia, Pa.
 Essley Mch. Co., E. L., Chicago, Ill.
 Garvin Mch. Co., Spring and Varick Sts., New York.

Hill, Clarke & Co., Inc., Boston, Mass.
 Hill, Clarke & Co., of Chicago, 625 Washington Blvd., Chicago, Ill.
 Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.

Marshall & Huschart Mch. Co., 17 S. Jefferson St., Chicago, Ill.
 McDonough Mfg. Co., Eau Claire, Wis.
 Motch & Merryweather Mch. Co., Cleveland, O.

Niles-Bement-Pond Co., 111 Broadway, New York.
 Osgood Tool Co., J. L., Buffalo, N. Y.
 Patterson Tool & Supply Co., Dayton, O.

Simmons Mch. Co., 1001 Singer Bldg., New York.
 Vandyck Churchill Co., 149 Broadway, New York.
 Walls Tool Co., T. P., 75 Walker St., New York.

Young, Corley & Dolan, Inc., 115 Broadway, New York.
Machinists' Small Tools
 See Calipers, Hammers, Wrenches, Drills, Taps, etc.

Mallets, Rawhide
 Chicago Rawhide Mfg. Co., 1301 Elston Ave., Chicago, Ill.

Mandrels, Expanding and Solid
 See Arbors and Mandrels, Expanding and Solid.

Marking Machines
 Bickford Machine Co., Greenfield, Mass.
 Grant Mfg. & Mch. Co., N. W. Station, Bridgeport, Conn.

Martin Mch. Co., Greenfield, Mass.
 Noble & Westbrook Mfg. Co., Hartford, Conn.

Measuring Machines, Precision
 Pratt & Whitney Co., Hartford, Conn.
 Rogers Works, Inc., J. M., Gloucester City, N. J.

Swedish Gage Co., Inc., 16 W. 81st St., New York.
Metals, Bearing
 See Bearings, Bronze, Babbitt, etc., and Bushings, Brass, Bronze, etc.

Milling and Drilling Machines, Upright
 Knight Mch. Co., W. B., 2019 Lucas Ave., St. Louis, Mo.

Milling Attachments
 Adams Co., Dubuque, Iowa.
 Becker Milling Machine Co., Hyde Park, Mass.

Brown & Sharpe Mfg. Co., Providence, R. I.
 Cincinnati Milling Machine Co., Oakley, Cincinnati, O.
 Garvin Mch. Co., Spring and Varick Sts., New York.

Hendey Machine Co., Torrington, Conn.
 Ingersoll Milling Machine Co., Rockford, Ill.
 Kearney & Trecker Co., Milwaukee, Wis.

Kempsmith Mfg. Co., Milwaukee, Wis.
 LeBlond Mch. Tool Co., R. K., Cincinnati, O.
 Oesterlein Mch. Co., Cincinnati, O.

Porter-Cable Mch. Co., Syracuse, N. Y.
 Pratt & Whitney Co., Hartford, Conn.
 Rivett Lathe & Grinder Co., Brighton, Boston, Mass.

Rockford Milling Mch. Co., Rockford, Ill.
 Seneca Falls Mfg. Co., 330 Fall St., Seneca Falls, N. Y.
 Whitney Mfg. Co., Hartford, Conn.

Milling Machines, Automatic
 Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Bench
 Ames Co., B. C., Waltham, Mass.
 Carter & Hakes Co., Sterling Place, Winsted, Conn.

Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago, Ill.
 Rockford Milling Mch. Co., Rockford, Ill.
 Sloan & Chase Mfg. Co., Newark, N. J.

Van Norman Mch. Tool Co., Waltham Ave., Springfield, Mass.
Milling Machines, Circular, Continuous
 Becker Milling Mch. Co., Hyde Park, Mass.

Gould & Eberhardt, Newark, N. J.
Milling Machines, Hand
 Adams Co., Dubuque, Iowa.

Becker Milling Machine Co., Hyde Park, Mass.
 Bickett Mch. & Mfg. Co., Cincinnati, O.
 Bickford Mch. Co., Greenfield, Mass.

Riggs-Watterson Co., Cleveland, O.
 Carter & Hakes Co., Sterling Place, Winsted, Conn.
 Cleveland Milling Mch. Co., Cleveland, O.

Garvin Mch. Co., Spring and Varick Sts., New York.
 Hendey Machine Co., Torrington, Conn.
 Ingersoll Milling Machine Co., Rockford, Ill.

Kearney & Trecker Co., Milwaukee, Wis.
 Kempsmith Mfg. Co., Milwaukee, Wis.
 LeBlond Mch. Tool Co., R. K., Cincinnati, O.

Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
 Niles-Bement-Pond Co., 111 Broadway, New York.
 Oesterlein Mch. Co., Cincinnati, O.

Rockford Milling Mch. Co., Rockford, Ill.
 Rowbottom Mch. Co., Waterbury, Conn.
 Van Norman Mch. Tool Co., Waltham Ave., Springfield, Mass.

Milling Machines, Lincoln Type
 Beaman & Smith Co., Providence, R. I.
 Becker Milling Mch. Co., Hyde Park, Mass.

Garvin Mch. Co., Spring and Varick Sts., New York.
 Kempsmith Mfg. Co., Milwaukee, Wis.
 Hendey Machine Co., Torrington, Conn.

Reynolds Pattern & Mch. Co., Massillon, O.
 Van Norman Mch. Tool Co., Waltham Ave., Springfield, Mass.

Milling Machines, Portable
 Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.

Pedrick Tool & Mch. Co., 3639 N. Lawrence St., Philadelphia, Pa.
 Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Vertical
 Adams Co., Dubuque, Iowa.
 Beaman & Smith Co., Providence, R. I.

Becker Milling Machine Co., Hyde Park, Mass.
 Brown & Sharpe Mfg. Co., Providence, R. I.
 Cincinnati Milling Mch. Co., Oakley, Cincinnati, O.

Garvin Mch. Co., Spring and Varick Sts., New York.
 Ingersoll Milling Mch. Co., Rockford, Ill.
 Kearney & Trecker Co., Milwaukee, Wis.

LeBlond Mch. Tool Co., R. K., Cincinnati, O.
 Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
 Niles-Bement-Pond Co., 111 Broadway, New York.

Van Norman Mch. Tool Co., Waltham Ave., Springfield, Mass.
Milling Tools (Hollow Adjustable)
 Geometric Tool Co., New Haven, Conn.

Rogers Works, Inc., J. M., Gloucester City, N. J.
Model and Experimental Work
 See Special Machinery and Tools.

Molding Machines
 Adams Co., Dubuque, Iowa.
 Mumford Molding Mch. Co., 1763 Elston Ave., Chicago, Ill.

Motors, Electric
 Eck Dynamo & Motor Co., Belleville, N. J.
 General Electric Co., Schenectady, N. Y.

Reliance Elec. & Eng. Co., 1056 Ivanhoe Road, Cleveland, O.
 Sprague Electric Works, 527 W. 34th St., New York.

Triumph Electric Co., Cincinnati, O.
 Wagner Electric Mfg. Co., St. Louis, Mo.
 Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Name Plates, Cast Bronze, Stamped and Etched
 Matthews & Co., Jas. H., 3946 Forbes Field, Pittsburgh, Pa.

Newman Mfg. Co., Cincinnati, O.
 Noble & Westbrook Mfg. Co., Hartford, Conn.
 Schwerdtle Stamp Co., Bridgeport, Conn.

Nichrome Castings
 Driver-Harris Co., Harrison, N. J.

Nipple Threading Machinery
 Bignall & Keeler Mch. Works, Edwardsville, Ill.
 Landis Mch. Co., Inc., Waynesboro, Pa.

Merrell Mfg. Co., 15 Curtis St., Detroit, Mich.
 Murchey Mch. & Tool Co., 34 Porter St., Detroit, Mich.
 Saunders' Sons, D., Yonkers, N. Y.

Standard Engineering Co., Ellwood City, Pa.
Nuts, Cast-Steel, Etc.
 Cincinnati Screw Co., Cincinnati, O.

Nut Tappers
 See Bolt and Nut Machinery.

Odometers
 Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn.

Oil Cups
 Bealy & Co., Chas. H., 120-B N. Clinton St., Chicago, Ill.

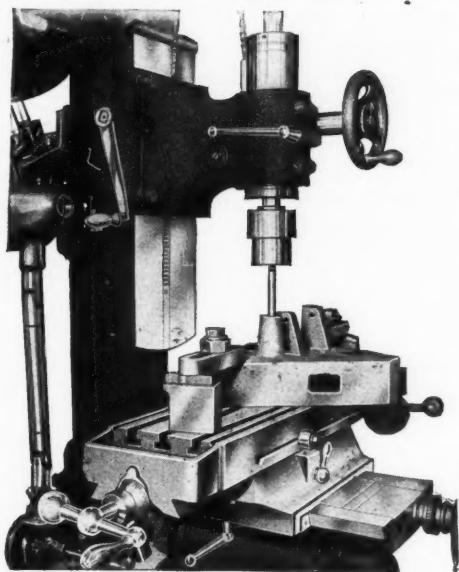
Gits Bros. Mfg. Co., 551 Monroe St., Chicago, Ill.
 Tucker, W. M. & C. F., Hartford, Conn.
 Winkley Co., Detroit, Mich.

Oilers, Loose Pulley
 Brown Engineering Co., 133 N. 3d Street, Reading, Pa.

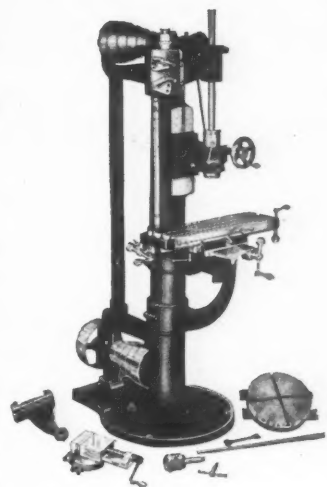
Oil Hole Covers
 Gits Bros. Mfg. Co., 551 Monroe St., Chicago, Ill.
 Tucker, W. M. & C. F., Hartford, Conn.

A KNIGHT Machine In a "Down East" Shop

One of the most productive machines the William Hall Co., Wollaston, Mass., owns is a No. 1½ Knight Milling and Drilling Machine. This concern



finds it without an equal for work having a number of angles and surfaces to machine, and for making dies, jigs, molds and metal patterns. It handles heavy milling just as readily as the lighter jobs, is easy to control, convenient in adjustments, and constructed to stand severe service.

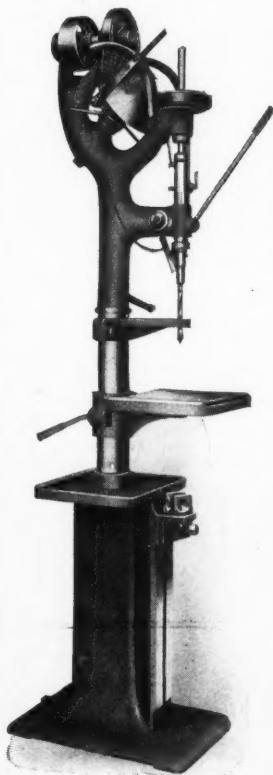


Knight Machines are made in two other sizes, both as efficient and productive in their particular fields as this one. Ask us about the one best fitted for your requirements.

W. B. KNIGHT MACHINERY COMPANY
2019-25 Lucas Avenue **ST. LOUIS, MISSOURI**

FOREIGN AGENTS: Coats Mch. Tool Co., Ltd., London, Glasgow and Newcastle-on-Tyne; R. L. Scrutton & Co., Sydney, Australia.

Don't Waste Time Measuring and Figuring— Buy the ALBANY DRILL



a light, high-speed precision drill, for holes up to ½ inch, capable of rapid adjustment to a wide range of speeds.

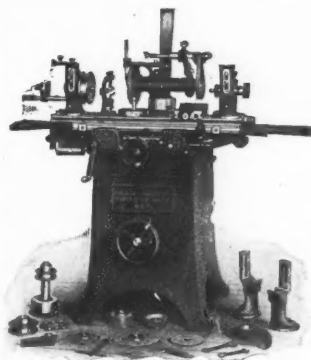
Index not only registers speed, but designates right speeds for various metals; micrometer depth gauge constantly registers the exact depth of cut in Metric or English measure—according to adjustment. No need to measure or figure—it's all right before you.

A touch of the lever changes the speed anywhere from 268 to 2140 R. P. M. without stopping the machine—while another as quickly starts or stops the spindle.

Ask for description of other
"Albany" features

**ALBANY HARDWARE
SPECIALTY MFG. CO.**
ALBANY, WISCONSIN

THE WALKER LINE



A Popular Tool Room Grinder

The Walker No. 2 is a service grinder, strong, rigid, speedy, accurate—a leader in its field.

It's a machine that meets modern requirements efficiently and economically and is as near wear proof as a grinder can be made. Furnished with complete assortment of wheels, wheel collets, cutter tooth gauges, wheel guards, etc. Full description on request.

O. S. WALKER CO.
MAGNETIC CHUCKS GRINDING MACHINES
Successors to O. S. Walker & Co. and Walker Grinder Co.
WORCESTER, MASSACHUSETTS, U.S.A.

Patents

Parker, C. L., Washington, D. C.

Pattern Shop Tools and MachineryCrescent Mch. Co., 56 Main St., Leetonia, O.
Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.Oliver Machinery Co., 7 Coldbrook St., Grand Rapids, Mich.
Seneca Falls Mfg. Co., 330 Fall St., Seneca Falls, N. Y.**Patterns, Wood and Metal**

Grant Mfg. & Mch. Co., N. W. Station, Bridgeport, Conn.

Mehl Mch. Tool & Die Co., Roselle, N. J.

S-P Mfg. Co., Cleveland, O.

Pencils, Drawing

American Lead Pencil Co., 237 5th Ave., New York.

Dixon Crucible Co., Joseph, Jersey City, N. J.

Phosphor Bronze

See Bronze.

Pipe Bending Tools

Underwood & Co., H. B., Philadelphia, Pa.

Pipe Cutting and Threading Machines

Armstrong Mfg. Co., 297 Knowlton St., Bridgeport, Conn.

Bignall & Keeler Mch. Works, Edwardsville, Ill.

Curtis & Curtis Co., 8 Garden St., Bridgeport, Conn.

Foote-Burt Co., Cleveland, O.

Greenfield Tap & Die Corp., Greenfield, Mass.

Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.

Hart Mfg. Co., E. 20th St. and Marion Ave., Cleveland, O.

Landis Mch. Co., Inc., Waynesboro, Pa.

Merrell Mfg. Co., 15 Curtis St., Toledo, O.

Murphy Mch. & Tool Co., 34 Porter St., Detroit, Mich.

Saunders' Sons, D., Yonkers, N. Y.

Standard Engineering Co., Ellwood City, Pa.

Treadwell Engineering Co., Easton, Pa.

Trimont Mfg. Co., Roxbury, Mass.

Victor Tool Co., Waynesboro, Pa.

Walworth Mfg. Co., Boston, Mass.

Wells & Son Co., F. E., Greenfield, Mass.

Pipe and Pipe Fittings

National Tube Co., Pittsburgh, Pa.

Newman Mfg. Co., Cincinnati, O.

Walworth Mfg. Co., Boston, Mass.

Planer Attachments

Cincinnati Planer Co., Cincinnati, O.

Gray Co., G. A., Cincinnati, O.

Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass.

Planers

American Tool Works Co., Cincinnati, O.

Cincinnati Planer Co., Cincinnati, O.

Cincinnati Shaper Co., Cincinnati, O.

Cleveland Planer Works, 3150-3152 Superior Ave., Cleveland, O.

Gray Co., G. A., Cincinnati, O.

Hamilton Machine Tool Co., Hamilton, O.

Morton Mfg. Co., Muskegon Heights, Mich.

Niles-Bement-Pond Co., 111 Broadway, New York.

Ohio Machine Tool Co., Kenton, O.

Sellers & Co., Inc., Wm., Philadelphia, Pa.

Whitcomb-Blaissell Mch. Tool Co., Worcester, Mass.

Wilson Mch. Co., W. A., Rochester, N. Y.

Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable

Morton Mfg. Co., Muskegon Heights, Mich.

Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.

Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary

Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.

Niles-Bement-Pond Co., 111 Broadway, New York.

Pedrick Tool & Mch. Co., 3639 N. Lawrence St., Philadelphia, Pa.

Underwood & Co., H. B., Philadelphia, Pa.

Plate Rolls

Niles-Bement-Pond Co., 111 Broadway, New York.

Plates, Steel

Moltrup Steel Products Co., Beaver Falls, Pa.

Pneumatic Tools

Independent Pneumatic Tool Co., Chicago, Ill.

Ingersoll-Rand Co., 11 Broadway, New York.

Keller Pneumatic Tool Co., Fond du Lac, Wis.

Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.

Polishing Machines

Abbott Ball Co., Elmwood, Hartford, Conn.

Bealy & Co., Chas. H., 120-B N. Clinton St., Chicago, Ill.

Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.

Brown & Sharpe Mfg. Co., Providence, R. I.

Builders Iron Foundry Co., Providence, R. I.

Diamond Machine Co., Providence, R. I.

Forbes & Myers, 178 Union St., Worcester, Mass.

Gardner Mch. Co., Beloit, Wis.

Goodell-Pratt Co., Greenfield, Mass.

Hisey-Wolf Mch. Co., Cincinnati, O.

New Britain Mch. Co., New Britain, Conn.

Ransom Mfg. Co., Oshkosh, Wis.

Roversford Fdry. & Mch. Co., 54 N. 5th St., Philadelphia, Pa.

Safety Emery Wheel Co., Springfield, O.

Sterling Grinding Wheel Co., Tiffin, O.

Stow Mfg. Co., Binghamton, N. Y.

United States Electrical Tool Co., 6th Ave. and Mt. Hope St., Cincinnati, O.

Wells & Son Co., F. E., Greenfield, Mass.

Portable Tools, Repair, Railroad, Etc.

Newman Mfg. Co., Cincinnati, O.

Pedrick Tool & Mch. Co., 3639 N. Lawrence St., Philadelphia, Pa.

Underwood & Co., H. B., Philadelphia, Pa.

Presses, Arbor

Atlas Press Co., 323 N. Park St., Kalamazoo, Mich.

Lucas Mch. Tool Co., Cleveland, O.

Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.

Presses, Branching

Ans Mch. Co., Max, Bridgeport, Conn.

Atlas Press Co., 323 N. Park St., Kalamazoo, Mich.

Bliss Co., E. W., 5 Adams St., Brooklyn, N. Y.

Ferracute Mch. Co., Bridgeport, N. J.

Hydraulic Press Mfg. Co., 84 Lincoln Ave., Mt. Gilead, O.

Metalwood Mfg. Co., Detroit, Mich.

Swaine Mfg. Co., F. J., St. Louis, Mo.

Toledo Mch. & Tool Co., Toledo, O.

Watson-Stillman Co., 192 Fulton St., New York.

Presses, Drop

See Hammers, Drop.

Presses, Foot and Screw

Baird Mch. Co., Bridgeport, Conn.

Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.

Bliss Co., E. W., 5 Adams St., Brooklyn, N. Y.

Etna Mch. Co., Toledo, O.

Ferracute Mch. Co., Bridgeport, N. J.

Niagara Mch. & Tool Works, Buffalo, N. Y.

Roversford Fdry. & Mch. Co., 54 N. 5th St., Philadelphia, Pa.

Shuster Co., F. B., New Haven, Conn.

Swaine Mfg. Co., F. J., St. Louis, Mo.

Taylor & Fenn Co., Hartford, Conn.

Toledo Mch. & Tool Co., Toledo, O.

Presses, Forging

Ans Mch. Co., Max, Bridgeport, Conn.

Bethlehem Steel Co., South Bethlehem, Pa.

Bliss Co., E. W., 5 Adams St., Brooklyn, N. Y.

Cleveland Mch. & Mfg. Co., 4944 Hamilton Ave., Cleveland, O.

Elmes Engineering Works, Chas. F., 222 N. Morgan St., Chicago, Ill.

Ferracute Mch. Co., Bridgeport, N. J.

Niagara Mch. & Tool Works, Buffalo, N. Y.

Swaine Mfg. Co., F. J., St. Louis, Mo.

Treadwell Mch. & Tool Co., Toledo, O.

Treadwell Engineering Co., Easton, Pa.

Presses, Hydraulic

Chambersburg Engineering Co., Chambersburg, Pa.

Elmes Engineering Works, Chas. F., 222 N. Morgan St., Chicago, Ill.

Hydraulic Press Mfg. Co., 84 Lincoln Ave., Mt. Gilead, O.

Metalwood Mfg. Co., Detroit, Mich.

Niles-Bement-Pond Co., 111 Broadway, New York.

Sellers & Co., Inc., Wm., Philadelphia, Pa.

Treadwell Engineering Co., Easton, Pa.

Watson-Stillman Co., 192 Fulton St., New York.

Presses, Power Forcing

Atlas Press Co., 323 N. Park St., Kalamazoo, Mich.

Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.

Elmes Engineering Works, Chas. F., 222 N. Morgan St., Chicago, Ill.

Lucas Mch. Tool Co., Cleveland, O.

Weaver Mfg. Co., Springfield, Ill.

Presses, Sheet Metal Working

Ans Mch. Co., Max, Bridgeport, Conn.

Automatic Mch. Co., Bridgeport, Conn.

Baird Mch. Co., Bridgeport, Conn.

Biggs-Watterson Co., Cleveland, O.

Bliss Co., E. W., 5 Adams St., Brooklyn, N. Y.

Buckeye Engine Co., Salem, O.

Cleveland Mch. & Mfg. Co., 4944 Hamilton Ave., Cleveland, O.

Ferracute Mch. Co., Bridgeport, N. J.

Niagara Mch. & Tool Works, Buffalo, N. Y.

Swaine Mfg. Co., F. J., St. Louis, Mo.

Toledo Mch. & Tool Co., Toledo, O.

Willard Mch. Tool Co., Cincinnati, O.

Presses, Shell Banding

West Tire Setter Co., Rochester, N. Y.

Presses, Straightening

Elmes Engineering Works, Chas. F., 222 N. Morgan St., Chicago, Ill.

Hydraulic Press Mfg. Co., 84 Lincoln Ave., Mt. Gilead, O.

Metalwood Mfg. Co., Detroit, Mich.

Morse Twist Drill & Mch. Co., New Bedford, Mass.

Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.

Watson-Stillman Co., 192 Fulton St., New York.

Presses, Trimming

Billings & Spencer Co., Hartford, Conn.

Bliss Co., E. W., 5 Adams St., Brooklyn, N. Y.

Cleveland Mch. & Mfg. Co., 4944 Hamilton Ave., Cleveland, O.

Erie Foundry Co., Erie, Pa.

Ferracute Mch. Co., Bridgeport, N. J.

Toledo Mch. & Tool Co., Toledo, O.

Press Guards

Safety Engineering Co., Cleveland, O.

Profiling Machines

Becker Milling Mch. Co., Hyde Park, Mass.

Bickett Mch. & Mfg. Co., Cincinnati, O.

Biggs-Watterson Co., Cleveland, O.

Garvin Mch. Co., Spring and Varick Sts., New York.

Leland-Gifford Co., Worcester, Mass.

Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.

Pratt & Whitney Co., Hartford, Conn.

Pulleys, Friction, Cone, Etc.

American Pulley Co., 4208-60 Wissahickon Ave., Philadelphia, Pa.

Brown Co., A. & F., 79 Barclay St., New York.

Brown & Sharpe Mfg. Co., Providence, R. I.

Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago, Ill.

Conway & Co., Cincinnati, O.

Crescon-Morris Co., Philadelphia, Pa.

Link-Belt Co., Chicago, Ill.

Mason & Co., Inc., Volney W., Providence, R. I.

Moore & White Co., 2707-2737 N. 15th St., Philadelphia, Pa.

Poole Eng. & Mch. Co., Baltimore, Md.

Saginaw Mfg. Co., Saginaw, Mich.

Sellers & Co., Inc., Wm., Philadelphia, Pa.

Wood Sons Co., T. B., Chambersburg, Pa.

Pulley Blocks

Yale & Towne Mfg. Co., 9 E. 40th St., New York.

Pulley Turning and Boring Machines

American Tool Works Co., Cincinnati, O.

Niles-Bement-Pond Co., 111 Broadway, New York.

Pump Leathers

Graton & Knight Mfg. Co., Worcester, Mass.

Pumps, Hydraulic

Buffalo Forge Co., Buffalo, N. Y.

Chambersburg Engineering Co., Chambersburg, Pa.

Elmes Engineering Works, Chas. F., 222 N. Morgan St., Chicago, Ill.

Hydraulic Press Mfg. Co., 84 Lincoln Ave., Mt. Gilead, O.

Metalwood Mfg. Co., Detroit, Mich.

Watson-Stillman Co., 192 Fulton St., New York.

Worthington Pump & Mch. Corp., 115 Broadway, New York.

Pumps, Lubricant and Oil

Rickford Mch. Co., Greenfield, Mass.

Brown & Sharpe Mfg. Co., Providence, R. I.

Fulco Pump Co., Cincinnati, O.

Inter-state Mch. Products Co., Inc., Rochester, N. Y.

Trahern Pump Co., Rockford, Ill.

Pumps, Pneumatic

Ingersoll-Rand Co., 11 Broadway, New York.

Worthington Pump & Mch. Corp., 115 Broadway, New York.

Pumps, Power Driven

Bethlehem Steel Co., South Bethlehem, Pa.

Pumps, Rotary

Inter-State Mch. Products Co., Inc., Rochester, N. Y.

Trahern Pump Co., Rockford, Ill.

Pumps, Steam

Buffalo Forge Co., Buffalo, N. Y.

Ingersoll-Rand Co., 11 Broadway, New York.

Worthington Pump & Mch. Corp., 115 Broadway, New York.

Pumps, Turbine Driven

Earle Gear & Mch. Co., 4705 Stanton Ave., Philadelphia, Pa.

Pumps, Vacuum

Leiman Bros., 62 E. John St., New York.

Punches and Dies

American Mch. & Foundry Co., 5520 2nd Ave., Brooklyn, N. Y.

Ans Mch. Co., Max, Bridgeport, Conn.

Bliss Co., E. W., 5 Adams St., Brooklyn, N. Y.

Columbus Die, Tool & Mch. Co., Columbus, O.

Harris Engineering Co., H. E., Bridgeport, Conn.

Krasberg Mfg. Co., 412 Orleans St., Chicago, Ill.

Nelson Tool Co., Inc., 781-783 E. 142d St., New York.

Pratt & Whitney Co., Hartford, Conn.

Roversford Fdry. & Mch. Co., 54 N. 5th St., Philadelphia, Pa.

Slocum, Avram & Slocum Laboratories, Inc., 531 W. 21st St., New York.

Swaine Mfg. Co., F. J., St. Louis, Mo.

Taft-Peirce Mfg. Co., Woonsocket, R. I.

Taylor-Shantz Co., Rochester, N. Y.

Toledo Mch. & Tool Co., Toledo, O.

Ulmer Co., J. C., Cleveland, O.

Punches, Centering

Brown & Sharpe Mfg. Co., Providence, R. I.

Goodell-Pratt Co., Greenfield, Mass.

Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.

Slocumb Co., J. T., Providence, R. I.

Starrett Co., L. S., Athol, Mass.

Punching and Shearing Machinery

Beaudry & Co., Inc., Boston, Mass.

Bethlehem Steel Co., South Bethlehem, Pa.

Bliss Co., E. W., 5 Adams St., Brooklyn, N. Y.

Buckeye Engine Co., Salem, O.

Buffalo Forge Co., Buffalo, N. Y.

Canton Foundry & Machine Co., Canton, O.

Cleveland Mch. & Mfg. Co., 4944 Hamilton Ave., Cleveland, O.

Ferracute Mch. Co., Bridgeport, N. J.

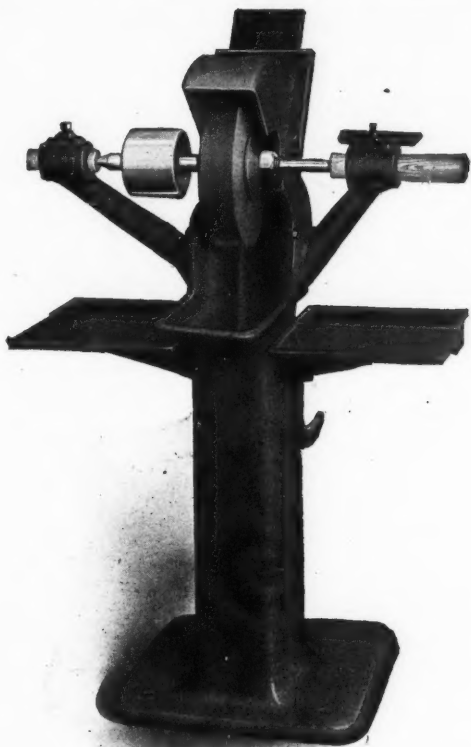
Mitts & Merrill, 843 Water St., Saginaw, Mich.

Niagara Mch. & Tool Works, Buffalo, N. Y.

Niles-Bement-Pond Co., 111 Broadway, New York.

Roversford Fdry. & Mch. Co., 54 N. 5th St., Philadelphia, Pa

BUILDERS

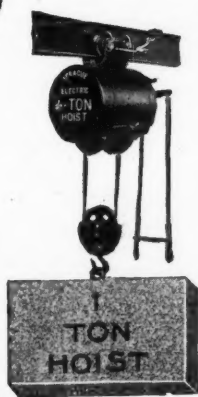


12-inch Polishing Wheel Stand

This machine is built with a very simple, practical means of disposing of polishing wheel dust. The stand is hollow and the wheel guard so shaped that the draught from the rapidly turning wheel carries the dust to the bottom of the stand. Blower connections can readily be made for removing the dust completely. The arbor is set in hard maple bearings held in place by case-hardened screws which are given firm bearing on blocks by iron shoes. The wheel is at the right height to enable operator to work while seated. Wheels up to 12" diameter by 3" face.

Get catalog for details.

BUILDERS IRON FOUNDRY
PROVIDENCE RHODE ISLAND



SPRAGUE ELECTRIC HOISTS

Save Time, Energy and Money

500 Lbs. to 6 Tons—A. C. or D. C.

Write for Pamphlet No. 90518

Sprague Electric Works
Of General Electric Company
Main Offices: 527-531 W. 34th St
New York

Branch Offices in Principal Cities



TUCKER OIL HOLE COVERS

Style D. Are embodied in specifications of modern machine construction. They are essential to the oil holes leading to the bearings of moving parts to be lubricated. The functions of oil hole covers are to protect the bearings, exclude foreign matter from the oil holes and designate to the operator the parts to be oiled. Send for Oiler Catalog No. 5. Select and request samples. Price will follow. All styles are worked with one hand or with oil can spout and are in the "safety first" class.



Opened.



Style A.



Style B.



Style C.



Style D.



Style E.



Style F. Drive.



Style G.

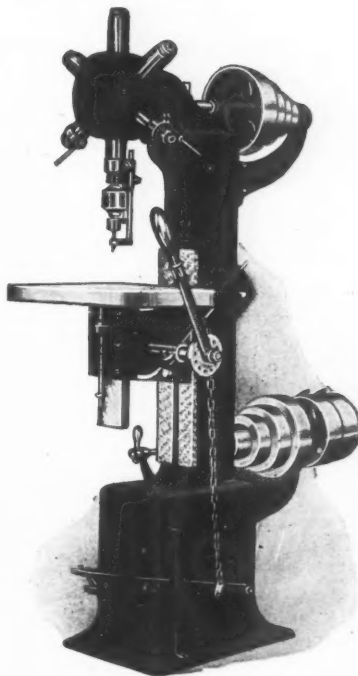
W. M. & C. F. TUCKER, Hartford, Conn., U.S.A.
FOREIGN AGENTS: Fenwick Freres & Co., Paris, France. C. W. Burton, Griffiths & Co., London, Eng.

QUINT TURRET DRILLS

Bore, Drill and Tap—all at one setting of the work

The No. 2 Pattern as shown is arranged for tapping, and is especially adapted for light work where accuracy is essential without stopping to change work or tools.

Reversing Tap Holder will tap to required depth and automatically back out more than twice as fast as when cutting. Independent stops for depth of holes. Only the spindle in use rotates. Made with from 4 to 12 spindles.



Catalogue for Full Description

A. E. QUINT, Hartford, Conn.

FOREIGN AGENTS: The Moscow Machine Tool and Eng. Co., Moscow, Russia. Ph. Bonvillain and E. Ronceray, Paris, France. C. W. Burton, Griffiths & Co., London, England.

Reamers, Portable Electric

Cincinnati Elec. Tool Co., Cincinnati, O.
Standard Electric Tool Co., Cincinnati, O.
Van Dorn Electric Tool Co., Cleveland, O.

Recorders, Time

Gisholt Mch. Co., Madison, Wis.

Recording Instruments for Pressure,

Temperature, Electricity,

Speed and Time

Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
General Electric Co., Schenectady, N. Y.
Gisholt Mch. Co., Madison, Wis.
Hoskins Mfg. Co., 459 Lawton Ave., Detroit, Mich.

Re-Cutting Milling Cutters, Reamers,

Saws, Etc.

Detroit Reamer Salvage Co., Detroit, Mich.

Sutherland Tool Co., Flint, Mich.

Relieving Machines

Cleveland Milling Machine Co., Cleveland, O.

Rheostats

General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Rifle Barrel Machinery

Baugh Mch. Tool Co., 200 Wason Ave., Springfield, Mass.

Diamond Mch. Co., Providence, R. I.

Pratt & Whitney Co., Hartford, Conn.

Reed-Prentice Co., F. E. Reed Dept. and Prentice

Bros. Dept., Worcester, Mass.

Sloan & Chase Mfg. Co., Ltd., Newark, N. J.

Rings, Weldless

Dyson & Sons, Joseph, Cleveland, O.

Johnston & Jennings Co., Addison Road and Lake

Shore R. R. Tracks, Cleveland, O.

Machinery Forging Co., Cleveland, O.

Riveters, Hydraulic

Chambersburg Engineering Co., Chambersburg, Pa.

Hanna Eng. Works, 1763 Elston Ave., Chicago, Ill.

Niles-Bement-Pond Co., 111 Broadway, New York.

Riveters, Pneumatic

Chicago Pneumatic Tool Co., 1060 Fisher Bldg.,

Chicago, Ill.

Hanna Eng. Works, 1763 Elston Ave., Chicago, Ill.

Independent Pneumatic Tool Co., Chicago, Ill.

Ingersoll-Rand Co., 11 Broadway, New York.

Riveters, Steam

Hanna Eng. Works, 1763 Elston Ave., Chicago, Ill.

Riveting Machines

Bilton Mch. Tool Co., Bridgeport, Conn.

Blomquist-Eck Mch. Co., Cleveland, O.

Buffalo Forge Co., Buffalo, N. Y.

Grant Mfg. & Mch. Co., N. W. Station, Bridgeport,

Conn.

Hanna Eng. Works, 1763 Elston Ave., Chicago, Ill.

High-Speed Hammer Co., Rochester, N. Y.

Niles-Bement-Pond Co., 111 Broadway, New York.

Shuster Co., F. B., New Haven, Conn.

Rivets, Standard and Special

Metal Specialty Mfg. Co., Waterbury, Conn.

Rolling Machines, Tapered Forging

Ajax Mfg. Co., Cleveland, O.

Williams, White & Co., Moline, Ill.

Rolling Mill Machinery

Ajax Mfg. Co., Cleveland, O.

Blake & Johnson Co., Waterbury, Conn.

Cleveland Mch. & Mfg. Co., 4944 Hamilton Av.,

Cleveland, O.

Fawcett Machine Co., Pittsburgh, Pa.

Rope Dressing and Preservative

Cling-Surface Co., 1018 Niagara St., Buffalo, N. Y.

Link-Belt Company, Chicago, Ill.

Rope Drives

Link-Belt Company, Chicago, Ill.

Rules, Steel

Brown & Sharpe Mfg. Co., Providence, R. I.

Goodell-Pratt Co., Greenfield, Mass.

Hammacher, Schlemmer & Co., 4th Ave. and 13th St.,

New York.

Keuffel & Esser Co., Hoboken, N. J.

Starrett Co., L. S., Athol, Mass.

Rust Preventives

Coats Mch. Tool Co., Inc., 30 Church St., New York.

Oakley Chemical Co., 26 Thames St., New York.

Safety Devices, Press, Lathe, Shaper,

Etc.

Safety Engineering Co., Cleveland, O.

Sand Blast Equipment

Curtis Pneumatic Mch. Co., 1568 Kienlen Ave., St.

Louis, Mo.

Leiman Bros., 62 E. John St., New York.

Link-Belt Company, Chicago, Ill.

Saw Blades

Atkins & Co., Inc., E. C., Indianapolis, Ind.

Blum & Co., Julius, 510 W. 24th St., New York.

Diamond Saw & Stamping Works, Buffalo, N. Y.

Diston & Sons, Inc., Henry, Philadelphia, Pa.

Goodell-Pratt Co., Greenfield, Mass.

Hammacher, Schlemmer & Co., 4th Av. and 13th St.,

New York.

Huth Bros. Saw Mfg. Co., 1108 University Ave.,

Rochester, N. Y.

Massachusetts Saw Works, Springfield, Mass.

Millers Falls Co., Millers Falls, Mass.

Montgomery & Co., Inc., 104 Fulton St., New York.

Napier Saw Works, Inc., Springfield, Mass.

Simonds Mfg. Co., Fitchburg, Mass.

Starrett Co., L. S., Athol, Mass.

Thompson & Son Co., Henry G., New Haven, Conn.

Union Tool Co., Orange, Mass.

West Haven Mfg. Co., New Haven, Conn.

Saw Guards, Circular

Atkins & Co., Inc., E. C., Indianapolis, Ind.

Sawing Machines, Wood

Barnes Co., W. F. & John, 231 Ruby St., Rockford,

Ill.

Crescent Mch. Co., 56 Main St., Leetonia, O.

Oliver Machinery Co., 7 Coldbrook St., Grand Rapids,

Mich.

Seneca Falls Mfg. Co., 330 Fall St., Seneca Falls,

N. Y.

Saws, Circular

Atkins & Co., Inc., E. C., Indianapolis, Ind.

Crescent Mch. Co., 56 Main St., Leetonia, O.

Diston & Sons, Inc., Henry, Philadelphia, Pa.

Huth Bros. Saw Mfg. Co., 1108 University Ave.,

Rochester, N. Y.

Napier Saw Works, Inc., Springfield, Mass.

Simonds Mfg. Co., Fitchburg, Mass.

Saws, Metal Band

Atkins & Co., Inc., E. C., Indianapolis, Ind.

Diston & Sons, Inc., Henry, Philadelphia, Pa.

Huth Bros. Saw Mfg. Co., 1108 University Ave.,

Rochester, N. Y.

Napier Saw Works, Inc., Springfield, Mass.

Thompson & Son Co., Henry G., New Haven, Conn.

West Haven Mfg. Co., New Haven, Conn.

Saws, Metal Band Machines

Armstrong-Blum Mfg. Co., 343 N. Francisco Ave.,

Chicago, Ill.

Racine Tool & Machine Co., Racine, Wis.

Thompson & Son Co., Henry G., New Haven, Conn.

Saws, Power Hack Machines

Armstrong-Blum Mfg. Co., 343 N. Francisco Ave.,

Chicago, Ill.

Atkins & Co., Inc., E. C., Indianapolis, Ind.

Coats Mch. Tool Co., Inc., 30 Church St., New York.

Diamond Saw & Stamping Works, Buffalo, N. Y.

Goodell-Pratt Co., Greenfield, Mass.

Massachusetts Saw Works, Inc., Springfield, Mass.

Millers Falls Co., Millers Falls, Mass.

Napier Saw Works, Inc., Springfield, Mass.

Peerless Machine Co., Racine, Wis.

Racine Tool & Machine Co., Racine, Wis.

Thompson & Son Co., Henry G., New Haven, Conn.

Western Tool & Mfg. Co., Springfield, O.

West Haven Mfg. Co., New Haven, Conn.

Saws, Rotary Machines

Billings & Spencer Co., Hartford, Conn.

Burr & Son, John T., 429 Kent Ave., Brooklyn, N. Y.

Cochrane-Bly Co., Rochester, N. Y.

Earle Gear & Mch. Co., 4705 Stenton Ave., Phila-

delphia, Pa.

Espen-Lucas Machine Works, Philadelphia, Pa.

Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.

Newton Mch. Tool Works, Inc., 23rd and Vine Sts.,

Philadelphia, Pa.

Nutter & Barnes Co., Hindsdale, N. H.

Vandeyk Churchill Co., 14 Broadway, New York.

Saw Sharpening Machines

Cochrane-Bly Co., Rochester, N. Y.

Newton Mch. Tool Works, Inc., 23rd and Vine Sts.,

Philadelphia, Pa.

Nutter & Barnes Co., New Haven, Conn.

Saw Tables

Baker Bros., Toledo, O.

Crescent Mch. Co., 56 Main St., Leetonia, O.

Oliver Machinery Co., 7 Coldbrook St., Grand Rapids,

Mich.

Scales, Weighing

National Scale Co., Chicopee Falls, Mass.

Scraping Tables

New Britain Mch. Co., New Britain, Conn.

Screw Cutting Tools

See Taps and Dies.

Screw Driving Machines

Reynolds Pattern & Mch. Co., Massillon, O.

Screw Machines, Automatic

Brown & Sharpe Mfg. Co., Providence, R. I.

Chicago Automatic Mch. Co., Chicago, Ill.

Cincinnati Automatic Mch. Co., Oakley, Cincinnati, O.

Cleveland Automatic Mch. Co., Cleveland, O.

Fitchburg Automatic Mch. Works, Fitchburg, Mass.

Macnab Mch. Co., John, 90 West St., New York.

National Acme Co., Cleveland, O.

New Britain Mch. Co., New Britain, Conn.

Pratt & Whitney Co., Hartford, Conn.

Screw Machines, Hand

See Lathes, Turret.

Acme Mch. Tool Co., Cincinnati, O.

Bardons & Oliver, Cleveland, O.

Biggs-Watterson Co., Cleveland, O.

Brown & Sharpe Mfg. Co., Providence, R. I.

Dresses Machine Tool Co., Cincinnati, O.

Foster Machine Co., Elkhart, Ind.

Garvin Mch. Co., Spring and Varick Sts., New York.

Himoff Mch. Co., 45 Mills St., Astoria, N. Y.

Jones & Lamson Mch. Co., Springfield, Vt.

Oliver Machinery Co., 7 Coldbrook St., Grand Rapids,

Mich.

Pierce Mch. Tool Co., 617 W. Jackson Blvd., Chicago,

Ill.

Potter & Johnston Mch. Co., Pawtucket, R. I.

Pratt & Whitney Co., Hartford, Conn.

Rivett Lathe & Grinder Co., Brighton, Boston, Mass.

Universal Mch. Co., Milwaukee, Wis.

Warner & Swasey Co., Cleveland, O.

Wells & Son Co., F. E., Greenfield, Mass.

Wood Turret Mch. Co., Brazil, Ind.

Screw Machines, Multiple Spindle

Cincinnati Automatic Mch. Co., Oakley, Cincinnati, O.

Fitchburg Automatic Mch. Works, Fitchburg, Mass.

National Acme Co., Cleveland, O.

New Britain Mch. Co., New Britain, Conn.

Screw Machine Tools and Equipment

Bardons & Oliver, Cleveland, O.

Brown & Sharpe Mfg. Co., Providence, R. I.

Chicago Automatic Mch. Co., Chicago, Ill.

Cincinnati Automatic Mch. Co., Oakley, Cincinnati, O.

Cleveland Automatic Mch. Co., Cleveland, O.

Foster Mch. Co., Elkhart, Ind.

Garvin Mch. Co., Spring and Varick Sts., New York.

Harris Engineering Co., H. E., Bridgeport, Conn.

Himoff Mch. Co., 45 Mills St., Astoria, N. Y.

Jones & Lamson Mch. Co., Springfield, Vt.

Macnab Mch. Co., John, 90 West St., New York.

National Acme Co., Cleveland, O.

New Britain Mch. Co., New Britain, Conn.

Oliver Machinery Co., 7 Coldbrook St., Grand Rapids,

Mich.

Pierce Mch. Tool Co., 617 W. Jackson Blvd., Chicago,

Ill.

Potter & Johnston Mch. Co., Pawtucket, R. I.

Pratt & Whitney Co., Hartford, Conn.

Warner & Swasey Co., Cleveland, O.

Wells & Son Co., F. E., Greenfield, Mass.

Wood Turret Mch. Co., Brazil, Ind.

Screw Machine Work

Albaugh-Dover Co., 2100 Marshall Blvd., Chicago, Ill.

Blum & Co., Julius, 510 W. 24th St., New York.

Brown Engineering Co., 133 N. 3d St., Reading, Pa.

Cincinnati Screw Co., Cincinnati, O.

Interstate Mch. Products Co., Inc., Rochester, N. Y.

Meisel Press Mfg. Co., 948 Dorchester Ave., Boston,

Mass.

National Acme Co., Cleveland, O.

Ohmer Fare Register Co., Dayton, O.

Toledo Screw Products Co., Toledo, O.

Screw Plates

Bay State Tap & Die Co., Mansfield, Mass.

Besly & Co., Chas. H., 120-B N. Clinton St.,

Chicago, Ill.

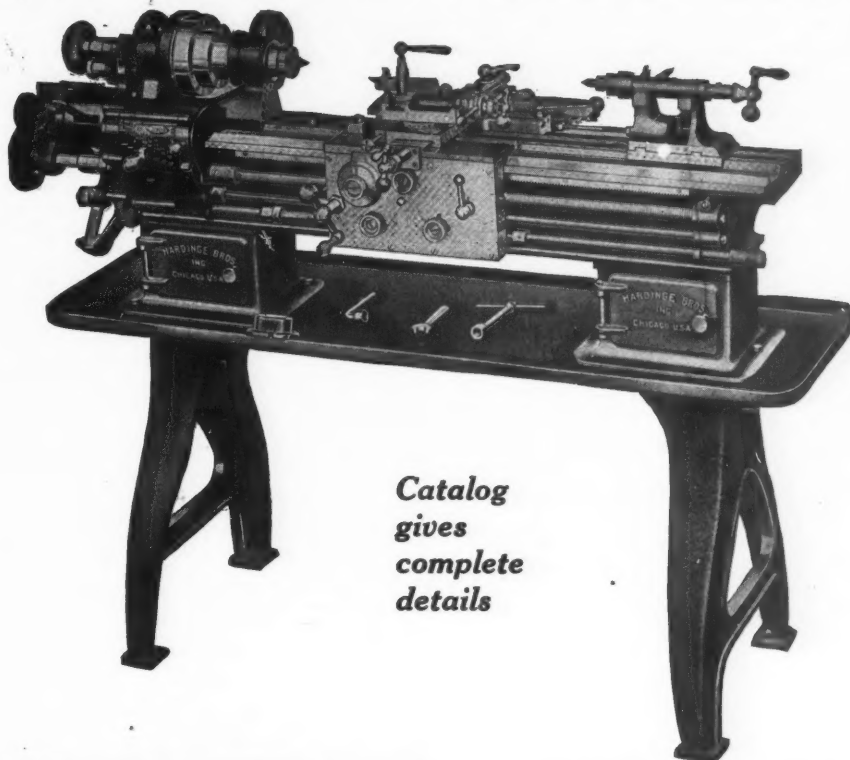
Brubaker & Bros., W. L., Millersburg, Pa.

Butterfield & Co.,

The Lathe That Does the Work of Two

The Cataract Quick Change Swing Precision Lathe is really two machines in one. It normally swings 9" but can readily be changed to 15" swing by means of raising blocks under the head- and tail-stocks.

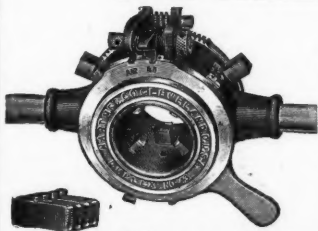
The practical advantage of this feature will appeal to the toolmaker and manufacturer of fine parts as singularly valuable. The lathe is substantially constructed throughout and capable of taking heavy cuts without the least chatter or vibration. The many other fine points of the Cataract are worthy your closest study.



*Catalog
gives
complete
details*

HARDINGE BROTHERS, Inc., Chicago, Ill.
Berteau and Ravenswood Avenues

GREATER EFFICIENCY THESE WORDS BRIEFLY EXPRESS HOW THE NEW "DUPLEX" DIE STOCK FOR THREADING PIPE



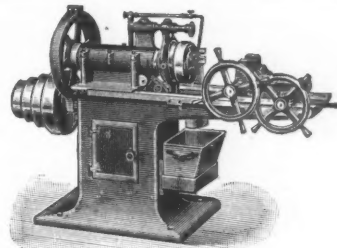
compares with similar tools; but there is much more in a detailed description of the new "Duplex" that will interest the merchant and user. Write for circulars.

THE HART MANUFACTURING CO.
E. 20th Street and Marion Avenue CLEVELAND, OHIO, U.S.A.

Bolt Threaders, Bolt Headers, Nut Tappers

Write us your needs in this line. Makers of Bolt and Nut Machinery and Forging Machines of every kind.

CATALOG
On Request



THE ACME MACHINERY CO.
CLEVELAND, OHIO, U. S. A.

FOREIGN AGENTS: Burton, Griffiths & Co., Ltd., London.



DO YOU CUT GEARS?

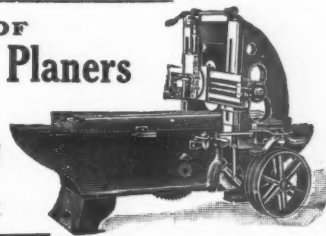
Then you'll be interested in the Flather Automatic Gear Cutting Machine. Let us cut your gears. Planed tooth, mitre and bevel gears a specialty. Guaranteed accuracy. Low cost.

E. J. FLATHER MFG. CO., Nashua, N. H.

BUILDERS OF Variable Speed Planers

Write us

**THE W. A. WILSON
MACHINE CO.**
ROCHESTER NEW YORK



Tools for Accurate Threading ECONOMICAL AND LONG LIVED



Send for catalog describing full line of taps, dies, screw plates, etc., and pick your next order from it.

BUTTERFIELD & CO., Derby Line, Vt.

Chicago, 11 So. Clinton Street
New York, 62 Reade Street

Detroit, 56 Cadillac Square
Canada, Rock Island, Que.

NO. 100R SET OF 10 PUNCHES



5 Drive Pin Punches, 1 Pin Starting Punch $\frac{1}{8}$ " point, 1 Prick Punch, 3 sizes Center Punches in Cloth Container. Order of your Tool Dealer.

Made by

The West Haven Mfg. Co., New Haven, Conn.

Slotters, Machine

Baker Bros., Toledo, O.
Dill Mch. Co., T. C., Philadelphia, Pa.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Slotters, Portable

Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.

Sockets, Sleeves, Collets, Etc.

Billings & Spencer Co., Hartford, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Fraser & Co., Peter A., 417 Canal St., New York.
Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
Montgomery & Co., Inc., 104 Fulton St., New York.
Morse Twist Drill & Machine Co., New Bedford, Mass.
National Twist Drill & Tool Co., Detroit, Mich.
Pratt & Whitney Co., Hartford, Conn.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitman & Barnes Mfg. Co., 1000 W. 120th St., Chicago, Ill.

Special Machinery and Tools

American Mch. & Foundry Co., 5520 2nd Ave., Brooklyn, N. Y.
Automatic Mch. Co., Bridgeport, Conn.
Automat Tool Works, 222 Greenwich St., New York.
Baird Mch. Co., Bridgeport, Conn.
Beaman & Smith Co., Providence, R. I.
Bilgram Mch. Works, 1231 Spring Garden St., Philadelphia, Pa.
Blake & Johnson Co., Waterbury, Conn.
Blanchard Machine Co., 64 State St., Cambridge, Mass.
Bliss Co., E. W., 5 Adams St., Brooklyn, N. Y.
Brown Co., A. & F., 79 Barclay St., New York.
Buffalo Foundry & Mch. Co., 10 Winchester Ave., Buffalo, N. Y.
Carroll Engineering Co., Dayton, O.
Columbus Die, Tool & Machine Co., Columbus, O.
Earle Gear & Mch. Co., 4705 Stenton Ave., Philadelphia, Pa.
Fawcett Machine Co., Pittsburgh, Pa.
Gardam & Sons, Inc., Wm., 108 Park Place, New York.
Garvin Mch. Co., Spring and Varick Sts., New York.
Gisholt Mch. Co., Madison, Wis.
Grant Mfg. & Mch. Co., N. W. Station, Bridgeport, Conn.
Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill.
Hannifin Mfg. Co., Chicago, Ill.
Harris Engineering Co., H. E., Bridgeport, Conn.
Hetherington-McCabe Co., Piqua, O.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Sons Co., E., Windsor Locks, Conn.
Ingle Machine Co., Rochester, N. Y.
Krasberg Mfg. Co., 412 Orleans St., Chicago, Ill.
Langelier Mfg. Co., Providence, R. I.
Lucas Machine Tool Co., Cleveland, O.
Mehl Mch. Tool & Die Co., Roselle, N. J.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston, Mass.
Meisselbach-Catucci Mfg. Co., 27 Congress St., Newark, N. J.
Middlesex Mch. Works, Middletown, Conn.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Mueller Mch. Tool Co., Cincinnati, O.
National Automatic Tool Co., Richmond, Ind.
National Machinery Co., Tiffin, O.
National Tool Co., Cleveland, O.
National Twist Drill & Tool Co., Detroit, Mich.
Nelson Tool Co., Inc., 781-783 E. 142nd St., New York.
New Britain Mch. Co., New Britain, Conn.
Newman Mfg. Co., Cincinnati, O.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
North Side Tool Works, Dayton, O.
Ohmer Fare Register Co., Dayton, O.
Pratt & Whitney Co., Hartford, Conn.
Reed-Prentice Co., F. E. Reed Dept. and Prentice Bros. Dept., Worcester, Mass.
Reliance Steel & Tool Co., Inc., 30 Church St., New York.
Shuster Co., F. B., New Haven, Conn.
Simonds Mfg. Co., Pittsburgh, Pa.
Slocum, Avram & Slocum Laboratories, Inc., 531 W. 21st St., New York.
S-P Mfg. Co., Cleveland, O.
Standard Engineering Co., Ellwood City, Pa.
Steel Products Engineering Co., Springfield, O.
Steiner Bros., Lima, O.
Swedish Gage Co., Inc., 16 W. 61st St., New York.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Taylor & Penn Co., Hartford, Conn.
Taylor-Shantz Co., Rochester, N. Y.
T. C. M. Mfg. Co., Harrison, N. J.
Toledo Mch. & Tool Co., Toledo, O.
Treadwell Engineering Co., Easton, Pa.
Ulmer Co., J. C., Cleveland, O.
Windau Tool Co., Cleveland, O.

Speed Changing Devices
Moore & White Co., 2707-2737 N. 15th St., Philadelphia, Pa.

Spring Coiling and Forming Machinery
Baird Machine Co., Bridgeport, Conn.

Spring
Barnes Co., Wallace, South and Parallel Sts., Bristol, Conn.
Blum & Co., Julius, 510 W. 24th St., New York.
Kokomo Spring Co., Kokomo, Ind.

Sprocket Chains
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Caldwell & Son Co., H. W., 17th St. and Western Ave., Chicago, Ill.
Cullman Wheel Co., 1339 Altgeld St., Chicago, Ill.
Diamond Chain & Mfg. Co., 240 W. Georgia St., Indianapolis, Ind.
Link-Belt Company, Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Philadelphia Gear Works, Vine and 11th Sts., Philadelphia, Pa.
Union Chain & Mfg. Co., Seville, O.
Whitney Mfg. Co., Hartford, Conn.
Woburn Gear Works, Woburn, Mass.

Sprockets
Boston Gear Works, Norfolk Downs, Mass.
Cullman Wheel Co., 1339 Altgeld St., Chicago, Ill.
Link-Belt Co., Chicago, Ill.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston, Mass.
Philadelphia Gear Works, Vine and 11th Sts., Philadelphia, Pa.
Woburn Gear Works, Woburn, Mass.

Squaring Machines

Bickford Machine Co., Greenfield, Mass.
Erie Foundry Co., Erie, Pa.

Stampings, Sheet Metal

Acklin Stamping Co., 1657 Dorr St., Toledo, O.
American Tool & Mfg. Co., Urbana, O.
Blum & Co., Julius, 510 W. 24th St., New York.
Fox Gun Co., A. H., Philadelphia, Pa.
Globe Mch. & Stamping Co., Cleveland, O.
Lansing Stamping & Tool Co., Lansing, Mich.
Rockford Metal Specialty Co., Rockford, Ill.
Solar Metal Products Co., Inc., Columbus, O.

Stamps, Letters and Figures, Steel

Hoggson & Pettis Mfg. Co., New Haven, Conn.
Matthews & Co., Jas. H., 3946 Forbes Field, Pittsburgh, Pa.
Newman Mfg. Co., Cincinnati, O.
Noble & Westbrook Mfg. Co., Hartford, Conn.
Pannier Bros. Stamp Co., Inc., Pittsburgh, Pa.
Schwerdtle Stamp Co., Bridgeport, Conn.

Steam Specialties

National Tube Co., Pittsburgh, Pa.
Reliance Gauge Column Co., 6008 Carnegie Ave., Cleveland, O.

Steel

Apex Steel Corporation, 50 Church St., New York.
Bethlehem Steel Co., South Bethlehem, Pa.
Blum & Co., Julius, 510 W. 24th St., New York.
Boker & Co., Inc., H., 101 Duane St., New York.
Camden Forge Co., Camden, N. J.
Colonial Steel Co., Pittsburgh, Pa.
Firth-Sterling Steel Co., McKeesport, Pa.
Fraser & Co., Inc., Peter A., 417 Canal St., New York.
Halcomb Steel Co., Syracuse, N. Y.
Hawkrige Bros. Co., Boston, Mass.
Heller Bros. Co., Newark, N. J.

Jessop & Sons, Inc., Wm., 91 John St., New York.
Johnston & Jennings Co., Addison Road and Lake Shore R. R. Tracks, Cleveland, O.

Latrobe Electric Steel Co., Latrobe, Pa.
Standard Alloys Co., Pittsburgh, Pa.
Vanadium-Alloys Steel Co., Pittsburgh, Pa.
Vulcan Crucible Steel Co., Aliquippa, Pa.

Steel, Cold Rolled Strip, Sheet and Wire

Driver-Harris Co., Harrison, N. J.

Steel, High Speed, Tool

Apex Steel Corporation, 50 Church St., New York.
Bethlehem Steel Co., South Bethlehem, Pa.
Blum & Co., Julius, 510 W. 24th St., New York.
Boker & Co., Inc., H., 101 Duane St., New York.
Colonial Steel Co., Pittsburgh, Pa.
Firth-Sterling Steel Co., McKeesport, Pa.
Fraser & Co., Inc., Peter A., 417 Canal St., New York.
Halcomb Steel Co., Syracuse, N. Y.
Hawkrige Bros. Co., Boston, Mass.
Haynes Stellite Co., Kokomo, Ind.
Heller Bros. Co., Newark, N. J.
Jessop & Sons, Inc., Wm., 91 John St., New York.
Latrobe Electric Steel Co., Latrobe, Pa.
Onondaga Steel Co., Inc., Syracuse, N. Y.
Reliance Steel & Tool Co., Inc., 30 Church St., New York.
Standard Alloys Co., Pittsburgh, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Vanadium-Alloys Steel Co., Pittsburgh, Pa.
Vulcan Crucible Steel Co., Aliquippa, Pa.

Steel, Machine

Apex Steel Corporation, 50 Church St., New York.
Bethlehem Steel Co., South Bethlehem, Pa.
Blum & Co., Julius, 510 W. 24th St., New York.
Boker & Co., Inc., H., 101 Duane St., New York.
Camden Forge Co., Camden, N. J.
Colonial Steel Co., Pittsburgh, Pa.
Firth-Sterling Steel Co., McKeesport, Pa.
Halcomb Steel Co., Syracuse, N. Y.
Hawkrige Bros. Co., Boston, Mass.
Jessop & Sons, Inc., Wm., 91 John St., New York.
Latrobe Electric Steel Co., Latrobe, Pa.
Standard Alloys Co., Pittsburgh, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Standard Alloys Co., Pittsburgh, Pa.
Vanadium-Alloys Steel Co., Pittsburgh, Pa.
Vulcan Crucible Steel Co., Aliquippa, Pa.

Steel Shelving, Racks, Barrels, Tables, Etc.

Manufacturing Equipment & Eng. Co., Framingham, Mass.
National Scale Co., Chicopee Falls, Mass.
New Britain Mch. Co., New Britain, Conn.

Stellite

Haynes Stellite Co., Kokomo, Ind.

Stocks, Die

See Taps and Dies.

Stones, Oil

American Emery Wheel Works, Providence, R. I.
Cabotundum Co., Niagara Falls, N. Y.
Norton Co., Worcester, Mass.
Vitrified Wheel Co., Westfield, Mass.

Stools, Steel

See Furniture, Shop and Drafting-room.

Straightening Machinery

Morse Twist Drill & Machine Co., New Bedford, Mass.
Niles-Bement-Pond Co., 111 Broadway, New York.
Shuster Co., F. B., New Haven, Conn.

Stud Setters, Opening

Errington Mechanical Laboratory, 39 Cortlandt St., New York.

Swaging Machines

Etna Machine Co., Toledo, O.
Excelsior Needle Co., Torrington, Conn.
Langelier Mfg. Co., Providence, R. I.

Switchboards

General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Switches

General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Tachometers and Thermometers

Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn.

Tapes, Measuring

Keuffel & Esser Co., Hoboken, N. J.
Starrett Co., L. S., Athol, Mass.
Ulmer Co., J. C., Cleveland, O.

Tapping Attachments and Devices

American Tool Works Co., Cincinnati, O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.

Beaman & Smith Co., Providence, R. I.

Bicknell-Thomson Co., Greenfield, Mass.
Cincinnati Bickford Tool Co., Oakley, Cincinnati, O.
Errington Mechanical Laboratory, 39 Cortlandt St., New York.

Geometric Tool Co., New Haven, Conn.
Hammond Mfg. Co., Cleveland, O.
Leland-Gifford Co., Worcester, Mass.
Modern Tool Co., 2nd and State Sts., Erie, Pa.
Newman Mfg. Co., Cincinnati, O.

Peter Bros. Mfg. Co., 135 Railroad Ave., Algonquin, Ill.
Procnier, Wm. L., 549 Washington Blvd., Chicago, Ill.

Quint, A. E., Hartford, Conn.

Wells & Son Co., F. E., Greenfield, Mass.

Whitney Mfg. Co., Hartford, Conn.

Tapping Machines

Acme Mch. Co., Cleveland, O.
Baker Bros., Toledo, O.
Fulton Foundry & Mch. Co., Brooklyn, N. Y.
Garvin Mch. Co., Spring and Varick Sts., New York.
Geometric Tool Co., New Haven, Conn.
Hammond Mfg. Co., Cleveland, O.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Harris Engineering Co., H. E., Bridgeport, Conn.
Langelier Mfg. Co., Providence, R. I.
Moline Tool Co., Moline, Ill.
National Mch. Co., Tiffin, O.
Peter Bros. Mfg. Co., 135 Railroad Ave., Algonquin, Ill.
Procnier, Wm. L., 549 Washington Blvd., Chicago, Ill.

Rockford Drilling Mch. Co., Rockford, Ill.

Saunders' Sons, D., Yonkers, N. Y.

Taps and Dies

Bay State Tap & Die Co., Mansfield, Mass.
Besly & Co., Chas. H., 120-B N. Clinton St., Chicago, Ill.

Brubaker & Bros., W. L., Millersburg, Pa.

Butterfield & Co., Derby Line, Vt.

Card Mfg. Co., S. W., Mansfield, Mass.

Carpenter Tap & Die Co., J. M., Pawtucket, R. I.

Errington Mechanical Laboratory, 39 Cortlandt St., New York.

Geometric Tool Co., New Haven, Conn.

Greenfield Tap & Die Corp., Greenfield, Mass.

Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.

Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago, Ill.

Harris Engineering Co., H. E., Bridgeport, Conn.

Hart Mfg. Co., E. 20th St. and Marion Ave., Cleveland, O.

Hjorth Lathe & Tool Co., Boston, Mass.

Morse Twist Drill & Machine Co., New Bedford, Mass.

National Acme Co., Cleveland, O.

Nicholson & Co., W. H., 112 Oregon St., Wilkes-Barre, Pa.

Pratt & Whitney Co., Hartford, Conn.

Reed Mfg. Co., Erie, Pa.

Reiff & Nestor, Lyons, Pa.

Reliance Steel & Tool Co., Inc., 30 Church St., New York.

Rogers Works, Inc., J. M., Gloucester City, N. J.

Saunders' Sons, D., Yonkers, N. Y.

Standard Tool Co., Cleveland, O.

Walworth Mfg. Co., Boston, Mass.

Wells & Son Co., F. E., Greenfield, Mass.

Taps, Collapsing

Errington Mechanical Laboratory, 39 Cortlandt St., New York.

Geometric Tool Co., New Haven, Conn.

Manufacturers' Equipment Co., 175 N. Jefferson St., Chicago, Ill.

Modern Tool Co., 2nd and State Sts., Erie, Pa.

Murphy Mch. & Tool Co., 34 Porter St., Detroit, Mich.

Victor Tool Co., Waynesboro, Pa.

Testing Outfits, Hydraulic

Metalwood Mfg. Co., Detroit, Mich.

Thread Cutting Machinery

Automatic Machine Co., Bridgeport, Conn.
Bickford Machine Co., Greenfield, Mass.
Boston Gear Works, Norfolk Downs, Mass.
Geometric Tool Co., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Lees-Bradner Co., Cleveland, O.
National Mch. Co., Tiffin, O.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Co., Brighton, Boston, Mass.
Wells & Son Co., F. E., Greenfield, Mass.

Thread Cutting Machines, Semi-automatic

Chicago Automatic Mch. Co., Chicago, Ill.
Macnab Mch. Co., John, 90 West St., New York.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.

Thread Cutting Tools

Rivett Lathe & Grinder Co., Brighton, Boston, Mass.

Thread Milling Machines

Bickford Mch. Co., Greenfield, Mass.
Biggs-Watterson Co., Cleveland, O.
Gisholt Mch. Co., Madison, Wis.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Lees-Bradner Co., Cleveland, O.
Newton Mch. Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa.

Pratt & Whitney Co., Hartford, Conn.

Smalley-General Co., Bay City, Mich.

Taft-Peirce Mfg. Co., Woonsocket, R. I.

T. C. M. Mfg. Co., Harrison, N. J.

Waltham Mch. Works, Waltham, Mass.

Thread Rolling Machines

Acme Mch. Co., Cleveland, O.

Blake & Johnson Co., Waterbury, Conn.

National Mch. Co., Tiffin, O.

Time Recorders, Workmen's Time on the Job

Gisholt Mch. Co., Madison, Wis.

Tire Welders and Benders

Williams, White & Co., Moline, Ill.

Tool Cases

Geratner & Sons, H., Dayton, O.
Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
Starrett Co., L. S., Athol, Mass.
Union Tool Chest Works, 10 Railroad St., Rochester, N. Y.
Wedell & Boers, Detroit, Mich.

IN THE ADVANCE

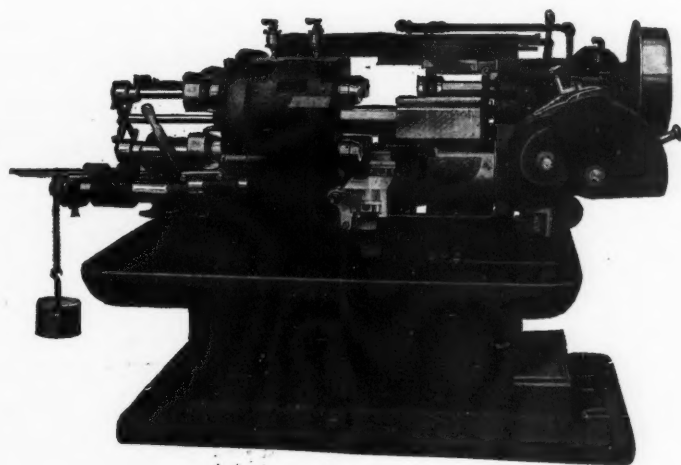
OF AUTOMATIC MACHINERY WILL BE FOUND

GRIDLEY AUTOMATICS

READY TO SERVE THEIR OWNERS

In the manufacture of duplicate parts from $\frac{1}{4}$ to $2\frac{3}{8}$ inches diameter (7" in length) the GRIDLEY MULTIPLE SPINDLE AUTOMATIC SCREW MACHINE is rapidly producing accurate pieces for hundreds of manufacturers.

The consistent and superior mechanical construction of GRIDLEY AUTOMATICS has established their reputation for RAPID PRODUCTION—UNIFORMITY OF OUTPUT and LOW OPERATING COSTS—as proved by the number of Gridleys in use and the continued demand for them.



The Gridley Multiple Spindle Automatic Screw Machine

Chuck Capacity Up to $2\frac{3}{8}$ " Feed 7"

FOUR SIZES OF MACHINES

*Send for our catalog
and also let us quote
on your specific product.*

THE NATIONAL ACME COMPANY

WINDSOR, VERMONT

GENERAL OFFICES, CLEVELAND, OHIO

CANADIAN SCREW PLANT, MONTREAL, P. Q.

BRANCH OFFICES:

NEW YORK

BOSTON

CHICAGO

DETROIT

ATLANTA

SAN FRANCISCO

WAREHOUSES: NEW YORK AND CHICAGO

REPRESENTATIVES IN FOREIGN COUNTRIES

*Makers of Gridley Single and Multiple-Spindle Automatics at Windsor, Vermont; and
Acme Automatics, Threading Dies, and Screw Machine Products at Cleveland, Ohio*

Tool Holders

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
 Billings & Spencer Co., Hartford, Conn.
 Cleveland Twist Drill Co., Cleveland, O.
 Gisholt Mch. Co., Madison, Wis.
 Hammacher, Schlemmer & Co., 4th Ave. and 13th St., New York.
 O. K. Tool Holder Co., Shelton, Conn.
 Osgood Tool Co., J. L., Buffalo, N. Y.
 Ready Tool Co., Bridgeport, Conn.
 Western Tool & Mfg. Co., Springfield, O.
 Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.
 Windau Tool Co., Cleveland, O.

Tool Salvage

Detroit Reamer Salvage Co., Detroit, Mich.

Tracing Cloth and Paper

Keuffel & Esser Co., Hoboken, N. J.

Tracing Filing Cabinets

See Cabinets, Filing.

Tracks, Trolley and Overhead

Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
 Northern Engineering Works, Detroit, Mich.
 Yale & Towne Mfg. Co., 9 E. 40th St., New York.

Transformers

Eck Dynamo & Motor Co., Belleville, N. J.
 General Electric Co., Schenectady, N. Y.
 Reliance Elec. & Eng. Co., 1056 Ivanhoe Road, Cleveland, O.
 Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Transmission Machinery

See Hangers, Shafting, Pulleys, Clutches, Couplings, Belting, Chain, etc.

Trolleys and Tramways

Box & Co., Alfred, Philadelphia, Pa.
 Curtis Pneumatic Mch. Co., 1568 Kienlen Ave., St. Louis, Mo.
 Wright Mfg. Co., Lisbon, O.
 Yale & Towne Mfg. Co., 9 E. 40th St., New York.

Trucks

Barrett-Cravens Co., 750 Transportation Bldg., Chicago, Ill.
 Chase Foundry & Mfg. Co., Columbus, O.
 Greenfield Tap & Die Corp., Greenfield, Mass.
 National Scale Co., Chicopee Falls, Mass.
 Transmission Ball Bearing Co., Inc., Buffalo, N. Y.

Trucks, Elevating

Barrett-Cravens Co., 750 Transportation Bldg., Chicago, Ill.
 Chase Foundry & Mfg. Co., Columbus, O.
 National Scale Co., Chicopee Falls, Mass.
 Stuebing Truck Co., Cincinnati, O.
 Transmission Ball Bearing Co., Inc., Buffalo, N. Y.

Tube Expanders

Watson-Stillman Co., 192 Fulton St., New York.

Tubing, Flexible

Almond Mfg. Co., T. R., 2 Maple Ave., Ashburnham, Mass.
 Wheelock Mfg. Co., Wheelock, Vermont.

Tubing, Seamless Steel

Blum & Co., Julius, 510 W. 24th St., New York.
 Frasse & Co., Inc., Peter A., 417 Canal St., New York.
 National Tube Co., Pittsburgh, Pa.
 Roux & Heyberger, 108 Rue Lafayette, Paris, France.
 Standard Parts Co., Cleveland, O.

Tubing, Steel

Blum & Co., Julius, 510 W. 24th St., New York.
 Frasse & Co., Inc., Peter A., 417 Canal St., New York.
 National Tube Co., Pittsburgh, Pa.
 Standard Parts Co., Cleveland, O.

Tubing, Welded Steel

Empire Art Metal Co., Inc., College Point, N. Y.
 Roux & Heyberger, 108 Rue Lafayette, Paris, France.

Tumbling Barrels

Abbott Ball Co., Elmwood, Hartford, Conn.
 Baird Mch. Co., Bridgeport, Conn.
 Globe Mch. & Stamping Co., Cleveland, O.
 Royersford Pdry. & Mch. Co., 54 N. 5th St., Philadelphia, Pa.

Turntables

Canton Foundry & Mch. Co., Canton, O.
 Chase Fdry. & Mfg. Co., Columbus, O.
 Link-Belt Company, Chicago, Ill.

Turret Attachments

Almond Mfg. Co., T. R., 2 Maple Ave., Ashburnham, Mass.
 Meisselbach-Catucci Mfg. Co., 27 Congress St., Newark, N. J.
 Newman Mfg. Co., Cincinnati, O.
 Phoenix Mfg. Co., Eau Claire, Wis.
 Pierce Mch. Tool Co., 617 W. Jackson Blvd., Chicago, Ill.
 Seneca Falls Mfg. Co., 330 Fall St., Seneca Falls, N. Y.

Turret Lathes, Vertical

Bullard Mch. Tool Co., Bridgeport, Conn.
 Pratt & Whitney Co., Hartford, Conn.

Twist Drills

See Drills, Twist.

Unions

Dart Mfg. Co., E. M., Providence, R. I.
 National Tube Co., Pittsburgh, Pa.

Universal Joints

Bausch Mch. Tool Co., 200 Wason Ave., Springfield, Mass.
 Boston Gear Works, Norfolk Downs, Mass.
 Gray & Prior Mch. Co., 38 Suffolk St., Hartford, Conn.

Valve Leathers

Graton & Knight Mfg. Co., Worcester, Mass.

Valves

Elmes Eng. Works, Chas. F., 222 N. Morgan St., Chicago, Ill.
 Hydraulic Press Mfg. Co., 84 Lincoln Ave., Mt. Gilead, O.
 Metalwood Mfg. Co., Detroit, Mich.
 National Tube Co., Pittsburgh, Pa.
 Watson-Stillman Co., 192 Fulton St., New York.

Varnish

Glidden Varnish Co., Cleveland, O.

Ventilating Apparatus

Buffalo Forge Co., Buffalo, N. Y.

Vise Stands

New Britain Mch. Co., New Britain, Conn.
 Western Tool & Mfg. Co., Springfield, O.

Vises, Bench

Athol Mch. Co., Athol, Mass.
 Billings & Spencer Co., Hartford, Conn.
 Goodell-Pratt Co., Greenfield, Mass.
 New Britain Mch. Co., New Britain, Conn.
 Prentiss Vise Co., 106 Lafayette St., New York.
 Reed Mfg. Co., Erie, Pa.
 Western Tool & Mfg. Co., Springfield, O.

Vises, Drill

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
 Brown Engineering Co., 133 No. 3d St., Reading, Pa.
 Carter & Hakes Co., Sterling Place, Winsted, Conn.
 Graham Mfg. Co., Providence, R. I.
 Skinner Chuck Co., New Britain, Conn.

Vises, Milling

New Jersey Mch. Exchange, Newark, N. J.

Vises, Pipe

Bignall & Keeler Mch. Works, Edwardsville, Ill.
 Butterfield & Co., Derby Line, Vt.
 Curtis & Curtis Co., 8 Garden St., Bridgeport, Conn.
 Reed Mfg. Co., Erie, Pa.
 Saunders' Sons, D., Yonkers, N. Y.
 Walworth Mfg. Co., Boston, Mass.
 Wells & Son Co., F. E., Greenfield, Mass.
 Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

Vises, Planer and Shaper

American Tool Works Co., Cincinnati, O.
 Cincinnati Planer Co., Cincinnati, O.
 Hendey Machine Co., Torrington, Conn.
 Sellow Mch. Tool Co., Pawtucket, R. I.
 Skinner Chuck Co., New Britain, Conn.

Vises, Universal Machine

Boston Scale & Mch. Co., Boston, Mass.
 Brown & Sharpe Mfg. Co., Providence, R. I.
 Brown Engineering Co., 133 No. 3d St., Reading, Pa.
 Graham Mfg. Co., Providence, R. I.
 New Jersey Mch. Exchange, Newark, N. J.
 Skinner Chuck Co., New Britain, Conn.

Voltmeters

Bristol Co., Waterbury, Conn.
 Brown Instrument Co., Philadelphia, Pa.
 General Electric Co., Schenectady, N. Y.

Washers, Leather

Graton & Knight Mfg. Co., Worcester, Mass.
 Schieren Co., Chas. A., 73 Ferry St., New York.

Washers, Spacing

See Collars, Spacing, etc.
 Maxwell-Hutchcroft Co., Cleveland, O.

Washstands and Bowls

Manufacturing Equipment & Eng. Co., Framingham, Mass.

Water Coolers

Allen Filter Co., Toledo, O.
 Manufacturing Equipment & Eng. Co., Framingham, Mass.

Welding and Cutting, Job

Davis-Bournonville Co., Jersey City, N. J.
 Electric Welding Co., Cleveland, O.
 General Electric Co., Schenectady, N. Y.
 National Electric Welder Co., Warren, O.
 Prest-O-Lite Co., Inc., 837 Speedway, Indianapolis, Ind.

Standard Parts Co., Cleveland, O.

Thomson Elec. Welding Co., Lynn, Mass.
 Thomson Spot Welder Co., Lynn, Mass.
 Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Welding and Cutting, Oxy-Acetylene

Davis-Bournonville Co., Jersey City, N. J.
 Prest-O-Lite Co., Inc., 837 Speedway, Indianapolis, Ind.

Welding Equipment, Electric Arc

Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Welding Machines, Electric

Electric Welding Co., Cleveland, O.
 General Electric Co., Schenectady, N. Y.
 National Electric Welder Co., Warren, O.
 Thomson Electric Welding Co., Lynn, Mass.
 Thomson Spot Welder Co., Lynn, Mass.

Welding Rods and Wire

Apex Steel Corporation, 50 Church St., New York.
 Davis-Bournonville Co., Jersey City, N. J.

Wire-Nail and Washer Machinery

National Mch. Co., Tiffin, O.

Wire Straighteners and Cutters, Automatic

Shuster Co., F. B., New Haven, Conn.

Wire Working Machinery

Baird Machine Co., Bridgeport, Conn.
 Cleveland Mch. & Mfg. Co., 4944 Hamilton Ave., Cleveland, O.
 Shuster Co., F. B., New Haven, Conn.

Wood Working Machinery

Crescent Mch. Co., 56 Main St., Leontia, O.
 New Britain Mch. Co., New Britain, Conn.
 Oliver Machinery Co., 7 Coldbrook St., Grand Rapids, Mich.
 Seneca Falls Mfg. Co., 330 Fall St., Seneca Falls, N. Y.
 Sidney Tool Co., Sidney, O.

Wrenches

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill.
 Armstrong Mfg. Co., 297 Knowlton St., Bridgeport, Conn.
 Athol Mch. Co., Athol, Mass.
 Billings & Spencer Co., Hartford, Conn.
 Coes Wrench Co., Worcester, Mass.
 Goodell-Pratt Co., Greenfield, Mass.
 Greene, Tweed & Co., 109 Duane St., New York.
 Trimont Mfg. Co., Roxbury, Mass.
 Walworth Mfg. Co., Boston, Mass.
 Wells & Son Co., F. E., Greenfield, Mass.
 Whitman & Barnes Mfg. Co., 1000 West 120th St., Chicago, Ill.
 Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

Wrenches, Pipe

Greene, Tweed & Co., 109 Duane St., New York.
 Reed Mfg. Co., Erie, Pa.
 Trimont Mfg. Co., Roxbury, Mass.
 Walworth Mfg. Co., Boston, Mass.
 Wells & Son Co., F. E., Greenfield, Mass.
 Whitman & Barnes Mfg. Co., 1000 West 120th St., Chicago, Ill.
 Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

Wrenches, Ratchet

Goodell-Pratt Co., Greenfield, Mass.
 Greene, Tweed & Co., 109 Duane St., New York.
 Trimont Mfg. Co., Roxbury, Mass.

Wrenches, Tap

Bealy & Co., Chas. H., 120-B N. Clinton St., Chicago, Ill.
 Brubaker & Bros., W. L., Millersburg, Pa.
 Butterfield & Co., Derby Line, Vt.
 Card Mfg. Co., S. W., Mansfield, Mass.
 Carpenter Tap & Die Co., J. M., Pawtucket, R. I.
 Greenfield Tap & Die Corp., Greenfield, Mass.
 Morse Twist Drill & Machine Co., New Bedford, Mass.
 Pratt & Whitney Co., Hartford, Conn.
 Standard Tool Co., Cleveland, O.
 Starrett Co., L. S., Athol, Mass.
 Trimont Mfg. Co., Roxbury, Mass.
 Union Tool Co., Orange, Mass.
 West Haven Mfg. Co., New Haven, Conn.

Machine Tools Electric Traveling Cranes

THE BIGGS-WATTERSON COMPANY
CLEVELAND, OHIO

Branches: Detroit Cincinnati Toledo

INGLE MACHINE COMPANY



Rochester Automatic Tooth Rounders

Made in 3 sizes, 12", 20" and 30"

Over One Thousand in Use in the
United States and Europe.

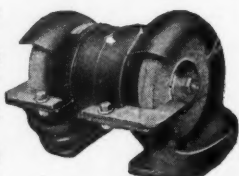
371-351 St. Paul St.

ROCHESTER, N. Y.

The Handy Grinder

This "F. & M." No. 56 is small in size only. Has high-grade high-speed motor in dust proof case, ball bearing spindles, swings 6" wheels. Has capacity beyond ordinary for machine shop. Other models for the blacksmith or foundry, and particularly for the pattern or wood working shop. Let us send circulars.

FORBES & MYERS
178 UNION ST. WORCESTER, MASS.



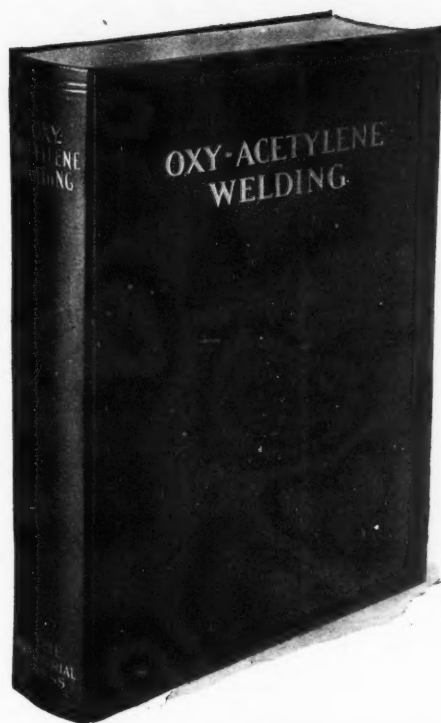
TOOLS

MONTGOMERY & COMPANY, Inc.
104 Fulton St., New York City

Have just issued a pamphlet known as
ODDS and ENDS
listing various small tools.
Send your name on a postal card for a copy.

OXY-ACETYLENE WELDING

By S. W. MILLER



A Comprehensive Treatise on the Practice of Welding Cast Iron, Malleable Iron, Steel, Copper, Brass, Bronze and Aluminum by the Oxy-acetylene Method, together with concise information on the Equipment required for both Welding and Cutting by this Process.

This volume describes the equipment required for oxy-acetylene welding and cutting, deals in detail with methods used in welding cast iron, malleable iron, steel, copper, brass, bronze and aluminum, and gives, in addition, special attention to the welding of sheet metal, tank welding, boiler repairs, etc., as well as to the subject of lead burning, which is a special kind of autogenous welding.

The Book Contains Twelve Chapters as Follows:

Equipment for Oxy-acetylene Welding.	Welding Aluminum.
Preparation of Work for Welding.	Sheet Metal, Boiler, Pipe, and Tube Welding.
Materials and Fluxes used for Welding.	Oxy-acetylene Welding of Tanks and Retorts.
Making Oxy-acetylene Welds.	General Considerations in Oxy-acetylene Welding.
Oxy-acetylene Welding of Cast Iron.	Lead Burning.
Welding Steel, Malleable Iron, Copper and Copper Alloys.	Cutting Metals with the Oxidizing Flame.

287 Pages. Price, \$2.50

Published by MACHINERY, 140-148 Lafayette Street, New York City

ALPHABETICAL INDEX OF ADVERTISERS

A

Abbott Ball Co.....276-317
Abrasive Co.....161
Acklin Stamping Co.....236
Acme Die-Casting Corporation.....258
Acme Gear Works, Inc.....266
Acme Mch. Co.....357
Acme Machine Tool Co.....25
Adams Co.....78
Advance Tool Co.....100
Ajax Mfg. Co.....109
Ajax Metal Co.....225
Albany Hardware Specialty Mfg Co.....353
Albaugh-Dover Co.....266
Albro-Clem Elevator Co.....267
Allen Filter Co.....303
Allen Mfg. Co.....302
Almond, T. R., Mfg. Co.....252
American Emery Wheel Works.....159
American Gas Furnace Co.....114
American Lead Pencil Co.....257
American Mch. & Foundry Co.....327
American Pulley Co.....206
American Swiss File & Tool Co.....126
American Tool & Mfg. Co.....323
American Tool Works Co.....14-15
Ames, B. C., Co.....90
Ams, Max, Machine Co.....236
Anderson Die Machine Co.....212
Apex Steel Corporation.....244
Arguto Oilless Bearing Co.....209
Armstrong-Blum Mfg. Co.....226
Armstrong Bros. Tool Co.....108
Armstrong Mfg. Co.....230
Athol Mch. Co.....303
Atkins, E. C., & Co., Inc.....226
Atlas Ball Co.....177
Atlas Press Co.....351
Auburn Ball Bearing Co.....202
Aurora Tool Works.....351
Automat Tool Works.....327
Automatic Machine Co.....279
Axelson Machine Co.....191

B

Baird Machine Co.....240
Baker Bros.....134
Baldwin Chain & Mfg. Co.....205
Ball & Roller Bearing Co.....209

Bantam Ball Bearing Co.....202
Barber-Colman Co.....30
Bardons & Oliver.....38
Barnes, W. F. & John, Co.....68
Barnes, Wallace, Co.....335
Barnes Drill Co., Inc.....192
Barnett, G. & H., Co.....347
Barrett-Cravens Co.....202
Baush Machine Tool Co.....8
Bay State Tap & Die Co.....267
Beaman & Smith Co.....13-253
Bearings Co. of America.....198
Beaudry & Co., Inc.....239
Becker Milling Mch. Co.....80-81
Bellevue Industrial Furnace Co.....242
Besly, Charles H., & Co.....151
Bethlehem Steel Co.....236
Bickett Mch. & Mfg. Co.....281
Bickford Machine Co.....233
Bicknell-Thomas Co.....252
Biggs-Watterson Co.....360
Bignall & Keeler Machine Works.....233
Billgram Machine Works.....262
Billings & Spencer Co.....171
Bilton Mch. Tool Co.....184
Bixby, R. W.....336
Blackall, Frederick S.....141
Blake & Johnson Co.....163
Blanchard Machine Co.....158
Bliss, E. W., Co.....237
Blomquist-Eck Machine Co.....317
Blount, J. G., Co.....162
Blum, Julius, & Co.....222
Boker, H., & Co., Inc.....118-305
Boston Gear Works.....261
Boston Scale & Mch. Co.....149-270
Bosworth, W. H.....312
Bound Brook Oil-less Bearing Co.....246
Box, Alfred, & Co.....199
Boye & Emmes Mch. Tool Co.....190
Bradford Mch. Tool Co.....9
Bradley, C. C., & Son, Inc.....132
Braun Gear Works.....264
Bridgeport Mch. Tool Wks.....10
Bridgeport Safety Emery Wheel Co., Inc.....144
Bristol Co.....Inside front cover
Brown, A. & F., Co.....208
Brown & Sharpe Mfg. Co.....103A-103B
Brown Clutch Co.....198
Brown Engineering Co.....248
Brown Instrument Co.....309
Brownell Mch. Co.....318
Brubaker, W. L., & Bros.....218

Bryant Chucking Grinder Co.....163
Buckeye Engine Co.....256
Buffalo Dental Mfg. Co.....231
Buffalo Forge Co.....231
Buffalo Fdry. & Mch. Co.....239
Builders Iron Foundry.....355
Bullard Mch. Tool Co.....55
Bunting Brass & Bronze Co.....290
Burr, John T., & Son.....147
Butterfield & Co.....357

C

Calder, Geo. H.....162
Caldwell, H. W., & Son Co.....245
Camden Forge Co.....72
Canedy-Otto Mfg. Co.....287
Canton Fdry. & Mch. Co.....200
Carborundum Co.....182
Card, S. W., Mfg. Co.....36
Carlton Mch. Tool Co.....228
Carpenter, J. M., Tap & Die Co.....272
Carroll Engineering Co.....326
Carroll-Jamieson Mch. Tool Co.....192
Carter & Hakes Co.....248
Cataract Refining & Mfg. Co.....305
Chambersburg Engineering Co.....240
Champion Tool Works Co.....236
Chard Lathe Co.....280
Chase Foundry & Mfg. Co.....201
Chicago Automatic Mch. Co.....187
Chicago Flexible Shaft Co.....10
Chicago Pneumatic Tool Co.....231
Chicago Rawhide Mfg. Co.....347
Cincinnati Automatic Mch. Co.....50
Cincinnati Ball Crank Co.....325
Cincinnati Bickford Tool Co.....26-27
Cincinnati Electrical Tool Co.....56
Cincinnati Gear Co.....262
Cincinnati Iron & Steel Co.....191
Cincinnati Lathe & Tool Co.....349
Cincinnati Milling Mch. Co.....103C
Cincinnati Planer Co.....24-50-318
Cincinnati Pulley Mch. Co.....316
Cincinnati Screw Co.....276
Cincinnati Shaper Co.....229
Clark, Jas. Jr., Electric Co., Inc.....213
Clark Equipment Co.....111
Classified Advertisements.....337
Cleveland Automatic Mch. Co.....68
Cleveland Mch. & Mfg. Co.....234

Cleveland Mch. & Supply Co., 122-312-318-325
Cleveland Mch. Tool Wks.....114
Cleveland Milling Mch. Co.....85
Cleveland Planer Works.....32
Cleveland Twist Drill Co.....31
Cling-Surface Co.....245
Coats Mch. Tool Co., Inc.....43
Cochrane-Bly Co.....345
Coes Wrench Co.....277
Colburn Mch. Tool Co.....138
Colonial Steel Co.....127
Columbus Die, Tool & Mch. Co.....332
Conway & Co.....200
Covington Multiple Drill Co.....100
Crescent Mch. Co.....192
Cresson-Morris Co.....201
Crofoot Gear Works, Inc.....261
Cullman Wheel Co.....201
Curtis & Curtis Co.....232
Curtis Pneumatic Mch. Co.....241
Cushman Chuck Co.....254

D

D & W Fuse Co.....251
Dale-Brewster Mch. Co., Inc.....310
Dalton Manufacturing Corp.....191-197
Dart, E. M., Mfg. Co.....208
Davis, Rodney.....266
Davis-Bourneville Co.....125
Davis, W. F., Mch. Tool Co.....321
Davis Mch. Tool Co., Inc.....301
Delta File Works.....351
DeMooy Mch. Co.....193
Desmond-Stephan Mfg. Co.....146
Detroit Grinding Wheel Co.....162
Detroit Reamer Salvage Co.....302
Detroit Stamping Co.....347
Detroit Twist Drill Co.....Front cover
Diamond Chain & Mfg. Co.....201
Diamond Mch. Co.....153
Diamond Saw & Stamping Works.....316
Dienelt & Eisenhardt, Inc.....240
Dill, T. C., Mch. Co.....65
Dillon Electric Co.....163
Diston, Henry, & Sons, Inc.....300
Dixon, Joseph, Crucible Co.....335
Doehler Die-Casting Co.....343
Dresses Mch. Tool Co.....18
Driver-Harris Co.....130-322
Dyson, Joseph, & Sons.....224

ALPHABETICAL INDEX OF ADVERTISERS

E
Earle Gear & Mch. Co.268-300
Eck Dynamo & Motor Co.213
Economy Drawing Table Co.275
Edgemont Mch. Co.245
Electric Welding Co.194
Elgin Tool Works325
Elmes, Charles F., Engineering Wks.241
Erie Foundry Co.238
Errington Mechanical Laboratory253
Espan-Lucas Mch. Works227
Easley, E. L., Mch. Co.317-322
Etna Mch. Co.345
Excelsior Needle Co.232

F
Factory & Mill Supply Co.322
Fafair Bearing Co.204
Fawcus Machine Co.262
Federal Machinery Sales Co.322
Fellows Gear Shaper Co.40-41
Ferracute Machine Co.236
Firth-Sterling Steel Co.220
Fiske Bros. Refining Co.220
Fitchburg Automatic Mch. Wks.92
Fitchburg Grinding Mch. Co.92
Fitchburg Machine Wks.93
Flather & Co., Inc.186
Flather, E. J., Mfg. Co.357
Footes Bros. Gear & Mch. Co.262-266
Footes-Burt Co.100
Forbes & Myers300
Ford Chain Block & Mfg. Co.198
Foreign Machinery Merchants338
Fosdick Mch. Tool Co.229
Foster Mch. Co.82
Fox, A. H., Gun Co.326
Franklin Mfg. Co.270
Fraser, Warren F., Co.145
Fraser, Peter A., & Co., Inc.323
Fulfo Pump Co.294
Fulton Foundry & Mch. Co.325

G
Gair, Robert, Co.325
Gardam, Wm., & Son, Inc.334
Gardner Mch. Co.180
Garvin Mch. Co.139
General Electric Co.112-140-210
Geometric Tool Co.44-45
Gerstner, H., & Sons244
Gilmer, L. H., Co.208
Gisholt Mch. Co.88-89
Gleason Mfg. Co.220
Gleason WorksBack cover
Glidden Varnish Co.231
Globe Mch. & Stamping Co.334
Goodard Tool Co.123
Goodell-Pratt Co.296
Goodyear Tire & Rubber Co.318
Gooley & Edlund, Inc.215
Gould & Eberhardt42
Graham Mfg. Co.172
Grand Rapids Grinding Mch. Co.148
Grant Gear Works, Inc.262
Grant Mfg. & Mch. Co.215
Graton & Knight Mfg. Co.178
Gray & Prior Mch. Co.259
Gray, G. A., Co.32
Greaves-Kluman Tool Co.56
Greene, Tweed & Co.347
Greenfield Mch. Co.144
Greenfield Tap & Die Corporation120-121
Gurney Ball Bearing Co.64
Gwilliam Co.208

H
Halcomb Steel Co.168
Hamilton Mch. Tool Co.52
Hammacher, Schlemmer & Co.107
Hammond Mfg. Co.166
Hannifin Mfg. Co.249
Hardinge Bros., Inc.357
Hardy, F. A., & Co.267
Harrington, Edwin, Son & Co., Inc.184-190
Harris, H. E., Engineering Co.341
Hart Mfg. Co.357
Hawkrige Bros. Co.203
Hawa, Geo. A., Inc.196
Haynes Steelite Co.291
Heald Machine Co.46-47
Heiler Bros. Co.222
Hendey Machine Co.339
Henry & Wright Mfg. Co.228
Hess-Bright Mfg. Co.59
Hetherington-McCabe Co.146
High-Speed Hammer Co.239
Hill, Clarke & Co., Inc.101-323
Hill, Clarke & Co. of Chicago319
Himoff Mch. Co.282
Hindley Gear Co.261
Hisey-Wolf Mch. Co.142
Hirth Lathe & Tool Co.335
Hoggson & Pettis Mfg. Co.254
Hoover Steel Ball Co.208
Horsburgh & Scott Co.260
Horton, E., & Son Co.252
Hoskins Mfg. Co.243
Hosmer, G. A., Co.220
Houston, Stanwood & Gamble Co.315
Hudson Motor Car Co.323
Hurtub, Rogers Mch. Co.233
Hutner Bros. Saw Mfg. Co.299
Hyatt Roller Bearing Co.70-71
Hydraulic Press Mfg. Co.235

I
Ideal Tool & Mfg. Co.210
Illinois Tool Works67
Independent Pneumatic Tool Co.213
Industrial Press306-307
Ingersoll Milling Mch. Co.22
Ingersoll-Rand Co.153
Ingie Mch. Co.360
International Mch. Tool Co.63
Inter-state Mch. Products Co. Inc.335

J
Jackson Mch. Tool Co.136
Jacobs Mfg. Co.255
Jensop, Wm., & Sons, Inc.172
Johnson & Miller325
Johnson Bronze Co.224
Johnson, Carlyle, Mch. Co.20
Johnson Mch. Tool Co.228
Johnston & Jennings Co.223
Jones & Lamson Mch. Co.16-17-76

K
Kasent Co.336
Kearney & Trecker Co.6
Kelly, R. A., Co.241
Kelly Reamer Co.249
Kempson Mfg. Co.23
Knuffel & Esser Co.256
Knight, W. B., Mch. Co.353
Kokomo Spring Co.274
Krasberg Mfg. Co.330

L
Landis Mch. Co., Inc.11
Landis Tool Co.155
Langelier Mfg. Co.311
Lansing Stamping & Tool Co.334
Lapointe, J. N., Co.87
Lapointe Mch. Tool Co.131
La Precision Mecanique228
Larrobe Electric Steel Co.175
LeBlond, R. K., Mch. Tool Co.21
Lees-Bradner Co.116-117
Lehmann Mch. Co.286
Leiman Bros.243
Leland-Gifford Co.2
Light Mfg. & Foundry Co.223
Linde Air Products Co., Inside front cover

Lindgren, F. W., Co.228
Link-Belt Company129
Littleford Bros.304
Lodge & Shipley Mch. Tool Co.7
Lucas Machine Tool Co.105
Lumen Bearing Co.225

M
Machinery Forging Co.225-266
Macnab, John, Mch. Co.187
Manning, Maxwell & Moore, Inc.202-253
Manufacturing Equipment & Eng. Co.275
Manufacturers Equipment Co.250
Marshall & Huchart Mch. Co.322
Martin Machine Co.325
Marvin & Casler Co.270
Marvin, W. B., Mfg. Co.322-327
Mason, Volney W., & Co., Inc.198
Massachusetts Saw Works136
Master Mch. Tool Co.185
Matthews, Jas. H., & Co.272-304
Maute, J., & Sons328
Maxwell-Hutchcroft Co.267
Mayer Bros. Co.238
McCroskey Reamer Co.237
McDonough Mfg. Co.150
Medina Machine Co.156
Mehl Machine Tool & Die Co.330
Meisel Press Mfg. Co.266
Meisselbach-Catucci Mfg. Co.264
Merrell Mfg. Co.230
Metal Specialty Mfg. Co.326
Metalwood Mfg. Co.235
Michigan Tool Co.95
Midcolex Machine Works145
Millers Falls Co.115
Miner & Peck Mfg. Co.239
Minster Mch. Co.147
Mitts & Merrill28
Moberg, C. J., Inc.225
Modern Mch. Tool Co.240
Modern Tool Co.77
Modern Tool, Die & Mch. Co.334
Moline Tool Co.225
Moltrup Steel Products Co.224
Monarch Mch. Tool Co.133
Montgomery & Co., Inc.360
Moore & White Co.197
Moore-Eastwood Mfg. Co.334
Morris Mch. Tool Co.90
Morris Chain Co.293
Morse Twist Drill & Mch. Co.22
Morton Mfg. Co.193
Motch & Merryweather Mch. Co.324
Mueller Mch. Tool Co.189
Murphy Mch. & Tool Co.216

N
Napier Saw Works, Inc.298
Narragansett Mch. Co.252
National Acme Co.196-280-359
National Automatic Tool Co.54
National Counting Mch. Co.256
National Electric Welder Co.119
National Lathe Co.301
National Mch. Co.282
National Tool Co.273
National Tube Co.160
National Twist Drill & Tool Co.97
National Scale Co.277
Nazel Engineering Works238
Neil & Smith Electric Tool Co.162
Nelson Tool Co., Inc.236
Newark Gear Cutting Mch. Co.264
New Britain Mch. Co.98-99-270
New Departure Mfg. Co.12
New Jersey Mch. Exchange145-249
Newman Mfg. Co.347
New Process Gear Corp.264-265
Newton Mch. Tool Wks., Inc.57
Niagara Mch. & Tool Wks.236
Nicholson, W. H., & Co.253
Nicholson File Co.34
Niles-Bement-Pond Co.4-5
Noble & Westbrook Mfg. Co.192

Norma Co. of America247
Northern Engineering Wks.200
Norton Co.156
Norton Grinding Co.152
Nottali, R. D., Co.259
Nutter & Barnes Co.214

O
Oakley Chemical Co.221
Oesterlein Mch. Co.241
Ohio Machine Tool Co.66
Ohmer Fare Register Co.336
O. K. Tool Holder Co.222
Oliver Instrument Co.192
Oliver Machinery Co.314
Oneda National Chuck Co.254
Onondaga Steel Co., Inc.276
Osgood, J. L., Tool Co.242
Ott Grinder Co.150

P
Pannier Bros. Stamp Co., Inc.273
Parker, C. L.336
Patterson Tool & Supply Co.314
Pedrick Tool & Mch. Co.214
Peerless Mch. Co.227
Persons-Arter Mch. Co.149
Peter Bros. Mfg. Co.250
Philadelphia Gear Works263
Phoenix Die Casting Co.190
Phoenix Mfg. Co.315
Pierce Mch. Tool Co.315
Poole Engineering & Mch. Co.262
Porter-Cable Mch. Co.113
Potter & Johnston Mch. Co.73
Pratt & Whitney Co.5
Precision Die Casting Co., Inc.174
Prentiss, Henry, & Co., Inc.315
Prentiss Vice Co.257
Prest-O-Lite Co., Inc.242
Procurier, William L.253
Puffer Mfg. Co.325

Q
Quint, A. E.355

R
Racine Tool & Mch. Co.183
Rahn-Larson Co.279
Ransom Mfg. Co.147
Ready Tool Co.252
Rearwin, W. D.213
Reed, Francis, Co.193
Reed Mfg. Co.248
Reed-Prentiss Co., F. E. Reed Dept.74-75
Reichhelm, E. P., & Co.126
Reiff & Nestor248
Reliance Electric & Eng. Co.143
Reliance Gauge Column Co.200
Reliance Steel & Tool Co., Inc.126
Reynolds Pattern & Mch. Co.168
Ricker-Shaffer Co.128
Riverside Mch. Depot324
Rivett Lathe & Grinder Co., Inside back cover

S
Safety Emery Wheel Co.144
Safety Engineering Co.257
Saginaw Mfg. Co.202
Saunders, J., Sons232
Savage, W. J., Co., Inc.281
Schellenbach-Hunt Tool Co.222
Schieren, Chas. A., Co.83-86
Schmidt, B. L., Co.146
Schwerdtle Stamp Co.267
Seully-Jones & Co.240-347
Sebastian Lathe Co., Inc.316
Sellers, Wm., & Co.164
Sellew Mch. Tool Co.316
Seneca Falls Mfg. Co.188
Shaw Electric Crane Co.202
Shore Instrument & Mfg. Co., Inc.276
Shuster, F. B., Co.349
Sibley Mch. Co.212
Sidney Tool Co.341
Silver Mfg. Co.345
Simmons Machine Co., Inc.147-323
Simonds Mfg. Co. (Fitchburg)102
Simonds Mfg. Co. (Pittsburgh)264
Sipp Machine Co.228
S K F Ball Bearing Co.48-49
Skinner Chuck Co.251
Sloan & Chase Mfg. Co., Ltd.3
Slocumb, J. T., Co.79
Slocum, Avram & Slocum Labora-
tories, Inc.154
Smalley-General Co.233
Smith & Mills Co.226
Smith, Philip, Mfg. Co.187
Smith-Serrell Co., Inc.197
Snyder, J. E., & Son3
Solar Metal Products Co.331
So-Luminum Mfg. Co.304
South Bend Lathe Works190
S-P Manufacturing Co.328
Sprague Electric Works355
Springfield Grinding Co.164
Springfield Mch. Tool Co.53
Stahl Gear & Mch. Co.267
Standard Alloys Co.196
Standard Electric Tool Co.308
Standard Engineering Co.231
Standard Gauge Steel Co.244
Standard Metal Mfg. Co.322
Standard Parts Co.217

Standard Pressed Steel Co.179
Standard Roller Bearing Co.207
Standard Tool Co.61
Star Corundum Wheel Co.146
Starrett L. S., Co.178
Steel Products Engineering Co.163
Steiner Bros.326
Stephoe, John, Co.286
Sterling Grinding Wheel Co.147
Stewart Mfg. Co.289
Stow Mfg. Co.212
Strong, Homer320
Strong, Carlisle & Hammond Co.165
Stuart, D. A., & Co., Inc.245
Stuebing Truck Co.275
Sutherland Tool Co.336
Swaine, Fred J., Mfg. Co.234
Swan & Finch Co.110
Swedish Gage Co., Inc.69

T
Taft-Pierce Mfg. Co.124
Taylor & Fenn Co.341
Taylor Mch. Co.311
Taylor-Shantz Co.327
T. C. M. Mfg. Co.310
Thomas Elevator Co.271
Thompson, Henry G., & Son Co.347
Thompson Grinder Co.146
Thomson Electric Welding Co.255
Thomson Spot Welder Co.284
Thurlow Steel Works, Inc.286
Titanium Alloy Mfg. Co.269
Toledo Bridge & Crane Co.200
Toledo Mch. & Tool Co.236
Toledo Screw Products Co.323
Trahern Pump Co.274
Transmission Ball Bearing Co., Inc.246
Treadwell Engineering Co.232
Trimont Mfg. Co.218
Triumph Electric Co.218
Trump Bros. Mch. Co.253
Tucker, W. M., & C. F.240-255
Turner Mch. Co.228

U
Ulmer, J. C., Co.327
Underwood, H. B., & Co.114
Union Chain & Mfg. Co.198
Union Mfg. Co.251
Union Switch & Signal Co.320-322
Union Tool Chest Works256
Union Tool Co.267
Union Twist Drill Co.39
United States Electrical Tool Co.37
United States Lathe & Mch. Co.76
Universal Boring Mch. Co.91
Universal Machinery Co.278
Urban Tool & Die Co.353
U. S. Ball Bearing Mfg. Co.263

V
Vanadium-Alloys Steel Co.170-244
Van Dorn & Dutton Co.290
Van Dorn Electric Tool Co.212
Vandrick Churchill Co.226
Van Norman Mch. Tool Co.244
Veeder Mfg. Co.244
Victor Tool Co.253
Vitified Wheel Co.162
Vulcan Crucible Steel Co.292
Vulcan Engineering Sales Co.241

W
Wade, Walter H.317
Wagner Electric Mfg. Co.211
Walcott Lathe Co.137
Walker, Chas. H.268
Walker, O. S., Co.353
Walls, T. P., Tool Co.272
Walsh, M. J., Mch. Co.323
Walsham Mch. Works317
Walworth Mfg. Co.3
Want Advertisements337
Warner & Swasey Co.60-61
Waterston, J. M.253
Watson-Stillman Co.234
Weaver Mfg. Co.325
Wedell & Boers248
Wells, F. E., & Son Co.148-304
Westcott Chuck Co.254
Western Tool & Mfg. Co.219
West Haven Mfg. Co.357
Westinghouse Elec. & Mfg. Co.180
Westinghouse Lamp Co.295
West Steel Casting Co.304-325-328
West Tire Setter Co.312
Wheelock Mfg. Co.225
Whitcomb-Blaissard Mch. Tool Co.167
Whitman & Barnes Mfg. Co.222
Whitney Mfg. Co.313
Whitton, D. E., Mch. Co.230
Willard Mch. Tool Co.190
Williams, J. H., & Co.33
Williams, White & Co.241
Willson, T. A., & Co., Inc.256
Willmarth & Morrison167
Wilson, W. A., Mch. Co.357
Wilson-Macaulen Co., Inc.213
Windau Tool Co.276
Winkley Company220
Wisconsin Electric Co.181
Woburn Gear Works262
Wood & Safford Mch. Wks.144
Wood, T. B., Sons Co.343
Wood Turret Mch. Co.62
Woodward & Powell Planer Co.190
Worcester Lathe Co.193
Worthington Pump & Machinery
Corporation280
Wright Mfg. Co.199
Wyman-Gordon Co.222

Y
Yale & Towne Mfg. Co.199
Young, Corley & Dolan, Inc.150

RIVETT Quality

No. 705 is a Plain Precision Turret Lathe for light manufacturing purposes, developed particularly for and highly efficient on many classes of work that are frequently performed on larger, therefore more expensive, machines. Frequently also, the amount of work to be performed does not warrant the purchase of an automatic type machine, in which case a Rivett No. 705 is just the tool.

We'd like to send you specifications and more details of this little turret lathe. Remember, please, it is a tool of genuine Rivett Quality—not to be compared with any cheap product.



The Rivett Lathe & Grinder Co.

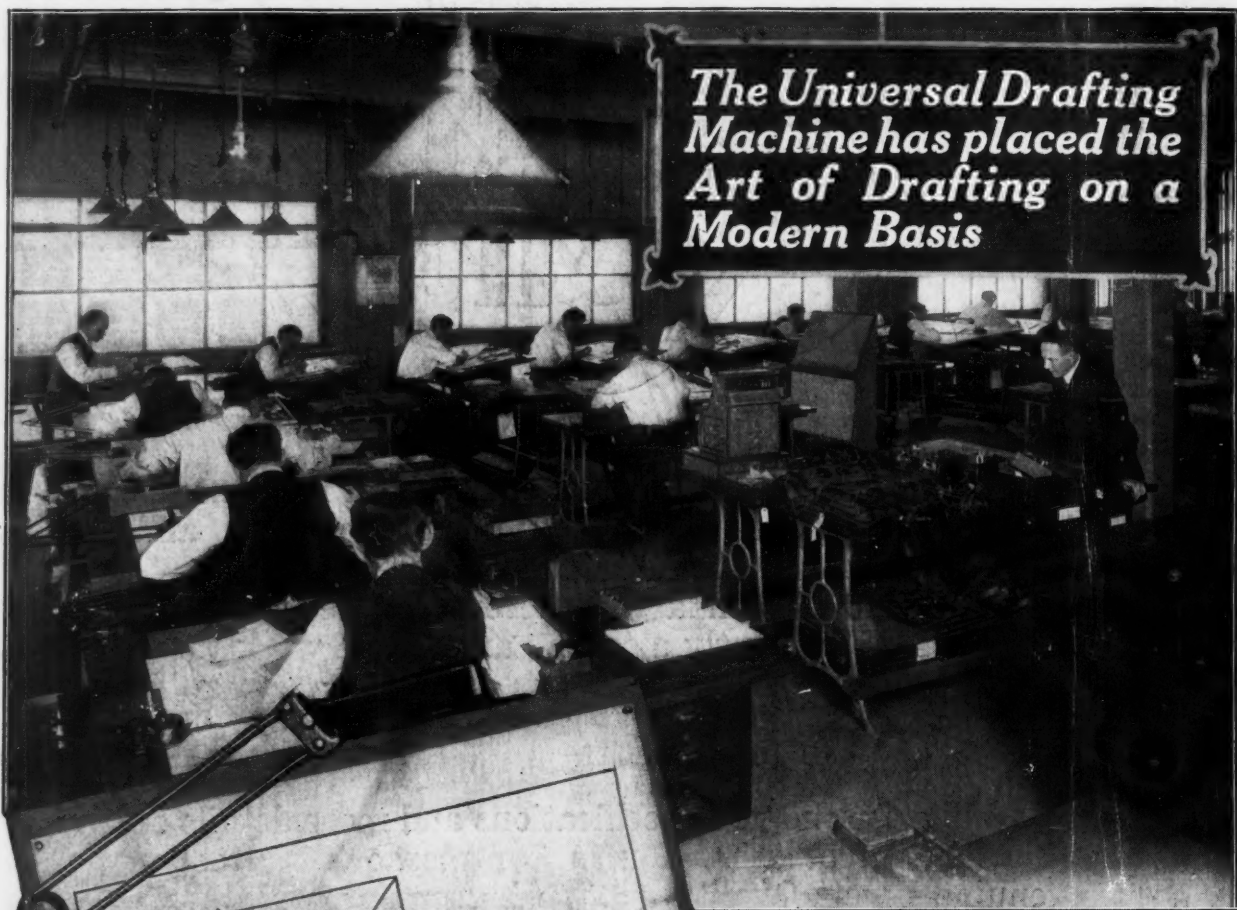
Brighton District
of Boston

DOMESTIC AGENTS

Henry Prentiss & Co., Inc., Boston, Mass., New York City, N. Y., Syracuse, N. Y., Rochester, N. Y., Buffalo, N. Y., Scranton, Pa.; W. E. Shipley Mchy. Co., Philadelphia, Pa.; Motch & Merryweather Mchy. Co., Pittsburgh, Pa., Cleveland, Ohio, Cincinnati, Ohio, Detroit, Mich.; Marshall & Huschart Mchy. Co., Chicago, Ill.; Marshall & Huschart Mchy. Co. of Indiana, Indianapolis, Ind.; Colcord Wright Mchy. and Supply Co., St. Louis, Mo.; F. E. Satterlee Co., Minneapolis, Minn.; Hendrie & Bolthoff Mfg. and Supply Co., Denver, Colo.; Utah Machinery Co., Salt Lake City, Utah; Hallidie Mchy. Company, Seattle, Wash.; Portland Machinery Co., Portland, Ore.; F. O. Stallman Supply Co., San Francisco, Cal.; Smith-Booth-Usher Co., Los Angeles, Cal.

FOREIGN AGENTS

For United Kingdom, Buck & Hickman, Ltd., 2 and 4 Whitechapel Rd., London, E. C.: 55 Station St., Birmingham, England; 3 Cross St., Manchester, England; 87 Pinstone St., Sheffield, England; 27 Cadogan St., Glasgow, Scotland. For France, Italy, Switzerland, Spain and Belgium, Fenwick Freres & Co., 8 Rue de Rocroy, Paris, France.



The Universal Drafting Machine has placed the Art of Drafting on a Modern Basis

Drafting Room—The National Cash Register Co., Dayton Ohio
Full Equipment of 100 Drafting Machines.

When time presses, the *Universal Drafting Machine* proves its greatest worth. It is a remarkable aid to clearness of thought, accuracy and rapidity of expression—and frequently saves its cost on a single job. It increases a good man's efficiency as much as 50 per cent.

A device of extreme accuracy, with easy, sensitive motion and practically trouble-proof. Big concerns everywhere are using it.

WRITE FOR CATALOG

Ball bearing joints, tubular rods, every working part adjustable, interchangeable protractors and scales—every convenience for all manner of mechanical work. Let us send detailed information.

UNIVERSAL DRAFTING MACHINE CO.
CLEVELAND, OHIO, U. S. A.

